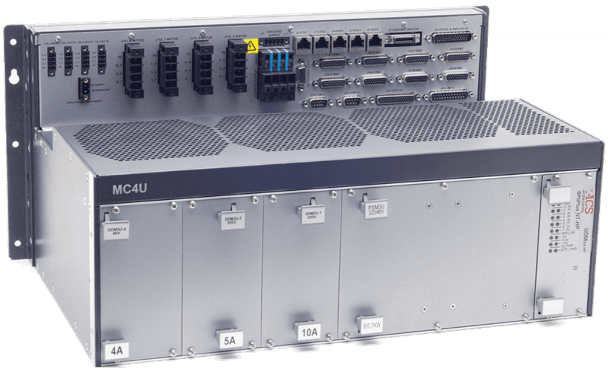
NanoPWM™



MC4U

Installation and Setup Guide

April 2022

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MC4U

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PATENTS

Israel Patent No. 235022
US Patent Application No. 14/532,023
Europe Patent application No.15187586.1
Japan Patent Application No.: 2015-193179
Chinese Patent Application No.: 201510639732.X
Taiwan(R.O.C.) Patent Application No. 104132118
Korean Patent Application No. 10-2015-0137612

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Revision History

Date	Revision	Description
April 2022	3.12	Correct Squared Sin-Cos Pinout, PSM3U-100V max voltage
November 2021	3.11.01	New Version Release
June 2021	3.10.01	Correct PSM3U-320V-20KW Input Voltage Range
April 2021	3.10	Safety warning
April 2019	2.70	Restored table of DC-DC Logic Supply Output Voltages
September 2018	2.60	Combined the following MC4U Control Module Harware Guides: > MC4U Control Module Hardware Guide v2.50.B (January 2018) > MC4U Control Module Hardware Guide v2.50.D (December 2017) > MC4U-NP Control Module Hardware Guide v2.40.C (August 2017)

Conventions Used in this Guide

Text Formats

Format	Description
Bold	Names of GUI objects or commands
BOLD + UPPERCASE	ACSPL+ variables and commands
`Monospace + grey background`	Code example
Italic	Names of other documents
Blue	Hyperlink
[ ]	In commands indicates optional item(s)
|	In commands indicates either/or items

Flagged Text

	Note - includes additional information or programming tips.
	Caution - describes a condition that may result in damage to equipment.
	Warning - describes a condition that may result in serious bodily injury or death.
	Model - highlights a specification, procedure, condition, or statement that depends on the product model
	Advanced - indicates a topic for advanced users.

Related Documentation

Documents listed in the following table provide additional information related to this document.

Authorized users can download the latest versions of the documents from ACS Downloads.

Document	Description
SPiiPlus Setup Guide	Provides communication, configuration and adjustment procedures for the MC4U Control Module motion controller.
SPiiPlus Utilities User Guide	A guide for using the SPiiPlus User Mode Driver (UMD) for setting up communication with the SPiiPlus motion controller.
ACSPL+ Programmer's Guide	Guide for using the ACSPL+ high level programming language.
SPiiPlus Command and Variable Reference Guide	Provides complete details of the ACSPL+ programming language command and variable set for programming SPiiPlus controllers.
SPiiPlus C Library Programmer Guide	Provides C++ and Visual Basic® libraries for host PC applications. This reference is specifically applicable for the MC4U Control Module motion controller.
SPiiPlus COM Library Programmer Guide	Provides COM Methods, Properties, and Events for Communication with the MC4U Control Module motion controller.
SPiiPlus .NET Library Programmer Guide	Provides .NET Methods, Properties, and Events for Communication with the MC4U Control Module motion controller.
SPiiPlus MMI Application Studio User Guide	A complete guide for using the SPiiPlus MMI Application Studio and associated monitoring tools
SPiiPlusNT/DC Motion Controller Hardware Guide	Provides details for the SPiiPlusNT-LT/HP and SPiiPlusDC-LT/HP motion controllers, one of which is installed in the MC4U Control Module.
SPiiPlus PDMnt Product Guide	Technical description of the SPiiPlus PDMnt Network Interface.

Document	Description
SPiiPlus SDMnt Product Guide	Technical description of the SPiiPlus SDMnt Step Motor Drive Module.
SPiiPlus UDMnt Product Guide	Technical description of the SPiiPlus UDMnt Universal Drive Module.
PEG and MARK Operations Application Notes	Provides details on using the PEG commands in SPiiPlus systems.
Using Absolute Encoders with ACS Products AN 3.00	Addresses the physical connections, configuration and operation of absolute encoders with ACS Motion Control networking products.
HSSI Expansion Modules Guide	High-Speed Synchronous Serial Interface (HSSI) for expanded I/O, distributed axes, and nonstandard devices.
SPiiPlus ADK Suite v2.50 Release Notes	Describes new features and changes that were introduced since the last SPiiPlusNT Suite version 2.40 release.

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1. Introduction

This document is intended for the use of engineers and technicians experienced in commissioning motion control systems.

The MC4U is a modular motion control system. The system is made of an enclosure, controller module, drive module(s), power supply module(s), and motherboard.

The configuraiton of a MC4U control module can be tailored to the needs of the application, thus optimizing the performance-to-cost ratio.

Each MC4U part number is unique and corresponds to the configuration as ordered.

This guide describes all versions of the MC4U control module and provides detailed hardware information. The information includes:

- A mechanical and electrical description of the components
- Connectivity information
- Safety, EMC, and circuit protection

This document is intended for the use of engineers and technicians experienced in commissioning motion control systems.

2. Installation and Maintenance

The MC4U is designed for easy installation and is relatively maintenance free.

2.1 Enclosures

There are five different sizes (widths) of MC4U enclosures. The enclosure size is defined in the MC4U configuration file or quotation file. All enclosures are panel mountable. The 19 inch and 22 inch width enclosure is either panel or rack mountable depending on the mounting brackets ordered.

The MC4U family includes the following models:

> MC4U-9-Piano-enc

> MC4U-11-Piano-enc

> MC4U-13-Piano-AX7

> MC4U-19-Piano-enc

> MC4U-22-Piano-enc

2.1.1 MC4U-9-Piano-enc

2.1.1.1 Product Overview

MC4U-9-Piano-enc can directly control two axes and contains the following plug-in components:

> A SPiiPlusNT/DC controller (Rev. B or Rev. D) or SPiiPlusNT/DC-NP (Rev. C)

> A power supply

> One high-power dual axis DDM3U-2-320V-YY motor drive

> A specific motherboard that accommodates the plug-in components and external interface connectors

The unit can only be panel-mounted.

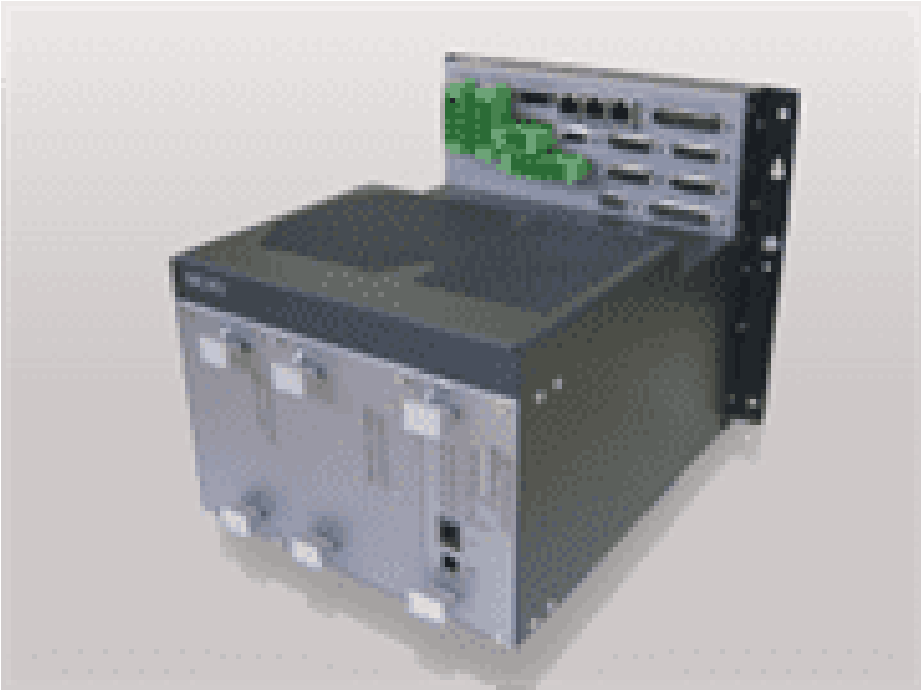


Figure 2-1. MC4U-9-Piano-enc

2.1.1.2 Dimensions

The following table provides the mechanical dimensions of the MC4U-9-Piano-enc.

Table 2-1. MC4U-9-Piano-enc Dimensions

Height	221.5 ±1mm
Width	273.8 ±1mm (with extractors 287.3mm)
Length	211 ±1mm (with mounting-bracket 250.7±1mm)

The following figure displays the overall dimensions of the MC4U-9-Piano-enc unit.

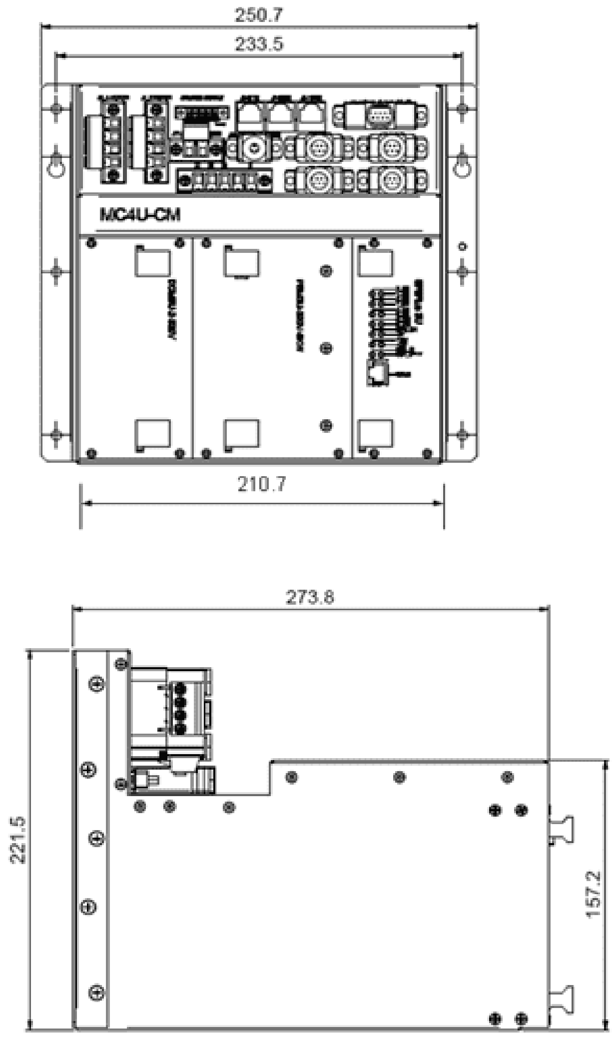


Figure 2-2. MC4U-9-Piano-enc Dimensions

2.1.1.3 Weight

The MC4U-9-Piano-enc has a maximum weight of 5.2 kg.

2.1.1.4 Cooling Vents

The MC4U-9-Piano-enc has one cooling vent.

Each vent provides a maximum of 120 CFM air flow for the internal cooling of the circuit boards within the mechanical housing. The cooling vents operate off the 24V logic supply. The cooling vents current consumption is 1A or less (depending on the number of vents).

For information regarding cooling vent periodical maintenance , see Maintenance.

2.1.2 MC4U-11-Piano-enc

2.1.2.1 Product Overview

MC4U-11-Piano-enc can directly control up to four axes and contains the following:

> A SPiiPlusNT/DC controller (Rev. B or Rev. D)
> A power supply
> Two high-power dual axis DDM3U-2-320V-YY motor drives
> A specific motherboard that accommodates the plug-in components and external interface connectors

The unit can only be panel-mounted.

Figure 2-3. MC4U-11-Piano-enc

2.1.2.2 MC4U-11-Piano-enc Dimensions

The following table provides the mechanical dimensions of the MC4U-11-Piano-enc.

Table 2-2. MC4U-11-Piano-enc Dimensions

Height	221.5 ±1mm
Width	273.8±1mm (with extractors 287.3mm)
Length	276.7±1mm (with mounting-bracket 316.7±1mm)

The following figure displays the overall dimensions of the MC4U-11-Piano-enc unit.

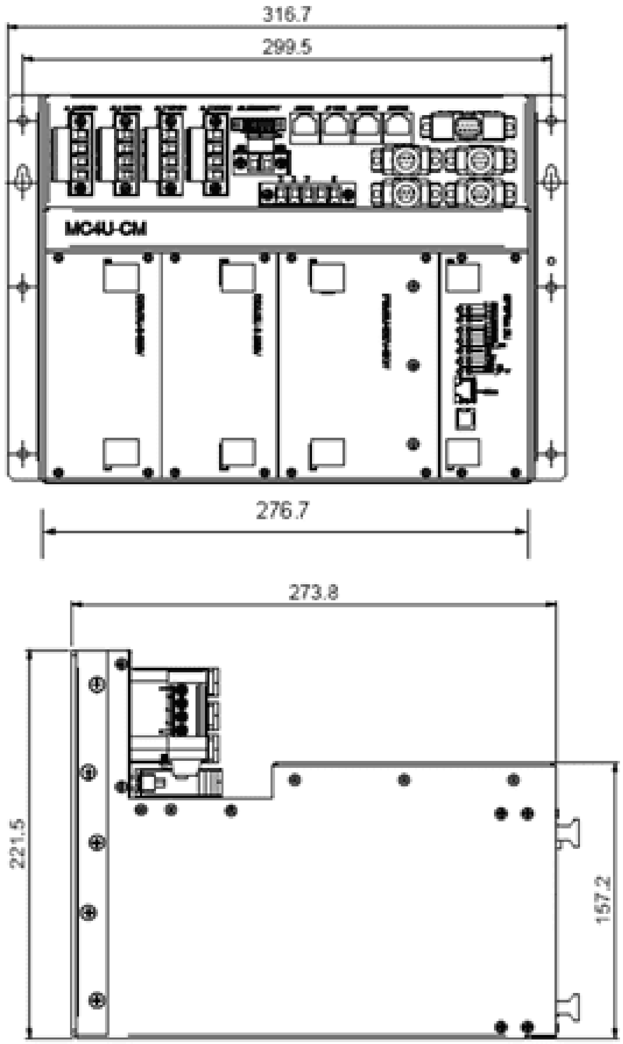


Figure 2-4. MC4U-11-Piano-enc Dimensions

2.1.2.3 Weight

The MC4U-11-Piano-enc has a maximum weight of 6.5 kg.

2.1.2.4 Cooling Vents

The MC4U-9-Piano-enc has two cooling vents.

Each vent provides a maximum of 120 CFM air flow for the internal cooling of the circuit boards within the mechanical housing. The cooling vents operate off the 24V logic supply. The cooling vents current consumption is 1A or less (depending on the number of vents).

For information regarding cooling vent periodical maintenance , see Maintenance.

2.1.3 MC4U-13-Piano-AX7

2.1.3.1 Product Overview

MC4U-13-Piano-AX7 can control 4 or 8 axes, depending on the SPiiPlus Motion Controller that is installed. It can contain:

- A SPiiPlusNT/DC motion controller (Rev. B or Rev. D)
- A PSM3U-320V-4kW (in the 4 axes version) or a PSM3U-320V-8kW (in the 8 axes version) power supply
- Two multi-axis motor drives
- MB4U-ASMB motherboard

> The unit can either rack- or panel-mounted.

Figure 2-5. MC4U-13-Piano-AX7

2.1.3.2 MC4U-13-Piano-AX7 Dimensions

The following table provides the mechanical dimensions of the MC4U-13-Piano-AX7.

Table 2-3. MC4U-13-Piano-AX7 Dimensions

Height	185 ±0.2mm
Width	> 340 ±0.2mm (without mounting

	brackets) > 383 ±0.2mm (with mounting brackets)
Length	292 ±1mm

The following figure displays the overall dimensions of the MC4U-13-Piano-AX7 unit.

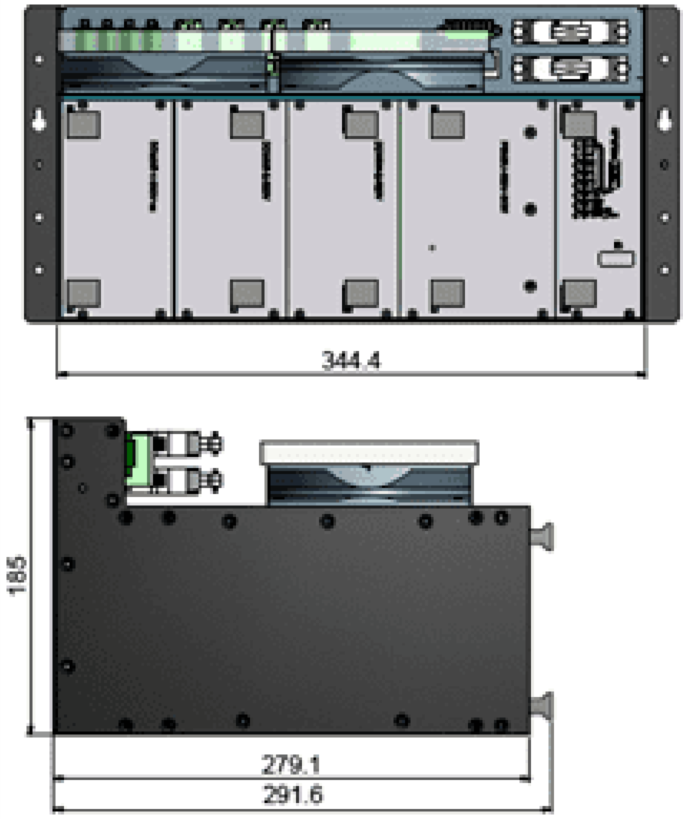


Figure 2-6. MC4U-13-Piano-AX7 Dimensions

2.1.3.3 Weight

The MC4U-13-Piano-AX7 has a maximum weight of 9.1 kg..

2.1.3.4 Cooling Vents

The MC4U-13-Piano-AX7 has two cooling vents.

Each vent provides a maximum of 120 CFM air flow for the internal cooling of the circuit boards within the mechanical housing. The cooling vents operate off the 24V logic supply. The cooling vents current consumption is 1A or less (depending on the number of vents).

For information regarding cooling vent periodical maintenance , see Maintenance.

2.1.4 MC4U-19-Piano-enc

2.1.4.1 Product Overview

MC4U-19-Piano-enc can control up to 8 axes. It provides the most flexibility with regards to type of drives (PWM, linear), matching power supplies and accessories. It can contain the following:

- A SPiiPlusNT/DC controller (Rev. B or Rev. D) or SPiiPlusNT/DC-NP (Rev. C)
- A power supply with one or two motor voltages
- Up to four multi-axis motor drives
- One or more motherboards that accommodate the plug-in components and the external interface connectors.

> The unit can either rack- or panel-mounted.

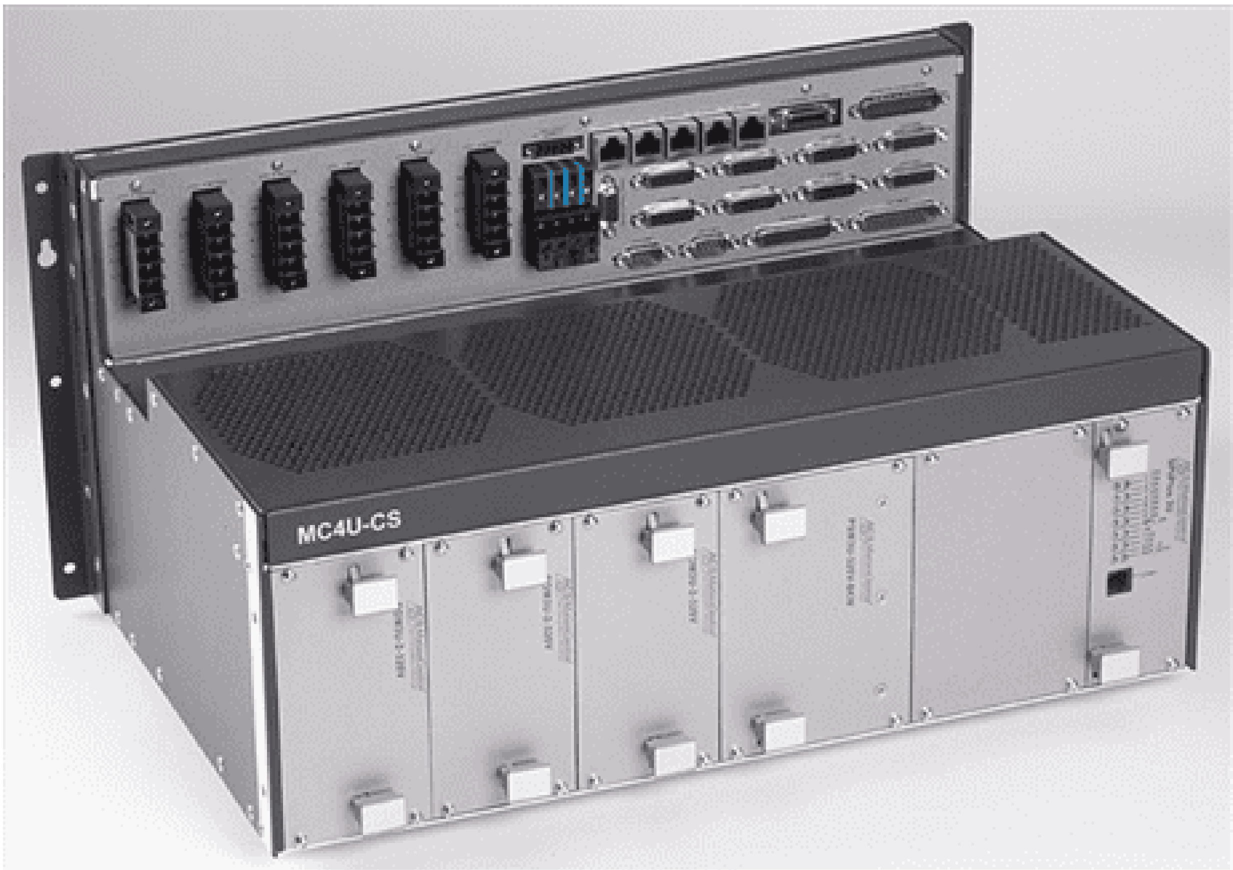


Figure 2-7. MC4U-19-Piano-enc

2.1.4.2 MC4U-19-Piano-enc Dimensions

Table 2-4. MC4U-19-Piano-enc Dimensions

The following table provides the mechanical dimensions of the MC4U-19-Piano-enc.

Height	221.5 ±1mm
Width	> 483 ±1mm (with front bracket) > 476 ±1mm (with rear bracket) > 436 ±1mm (with no bracket)
Length	292 ±1mm

The following figure displays the overall dimensions of the MC4U-19-Piano-enc unit.

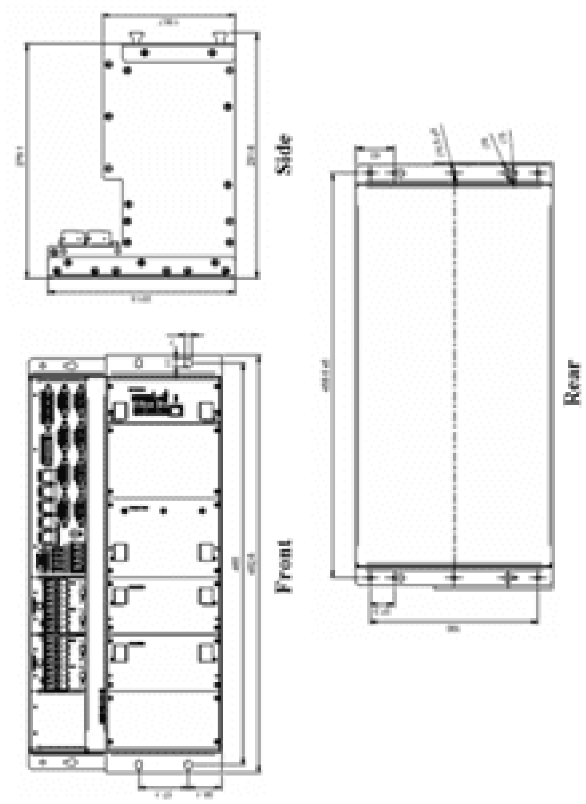


Figure 2-8. MC4U-19-Piano-enc Dimensions

2.1.4.3 Weight

The MC4U-19-Piano-enc has a maximum weight of 11.5 kg.

2.1.4.4 Cooling Vents

The MC4U-19-Piano-enc has three cooling vents.

Each vent provides a maximum of 120 CFM air flow for the internal cooling of the circuit boards within the mechanical housing. The cooling vents operate off the 24V logic supply. The cooling vents current consumption is 1A or less (depending on the number of vents).

For information regarding cooling vent periodical maintenance , see Maintenance.

2.1.5 MC4U-22-Piano-enc

2.1.5.1 Product Overview

MC4U-22-Piano-enc can control up to 8 axes. It is designed to support PWM drives with matching power supplies and accessories. It can contain the following:

- A SPiiPlusNT/DC controller (Rev. B or Rev. D) or SPiiPlusNT/DC-NP (Rev. C)
- One PSM3U-320V-10KW 320 V, 20 kW power supplyUp to four DDM3U-1-320V-XX-SR single-axis digital PWM motor drives 320V, 30/45A
- Motherboard:
  - MB5U-CON-PS2 - Motherboard for SPiiPlusNT/DC controller and two PSM3U-320V-10KW power supplies
  - MB5U-2-90A - Motherboard for DDM3U-1-XXX-XX drivers

> The unit can either rack or panel-mounted.

Figure 2-9. MC4U-22-Piano-enc

2.1.5.2 MC4U-22-Piano-enc Dimensions

The following table provides the mechanical dimensions of the MC4U-22-Piano-enc.

Table 2-5. MC4U-22-Piano-enc Dimensions

Height	221.5 ±1mm
Width	> 542 ±1mm (with rear bracket) > 502 ±1mm (with no bracket)
Length	292 ±1mm

The following figure displays the overall dimensions of the MC4U-22-Piano-enc unit.

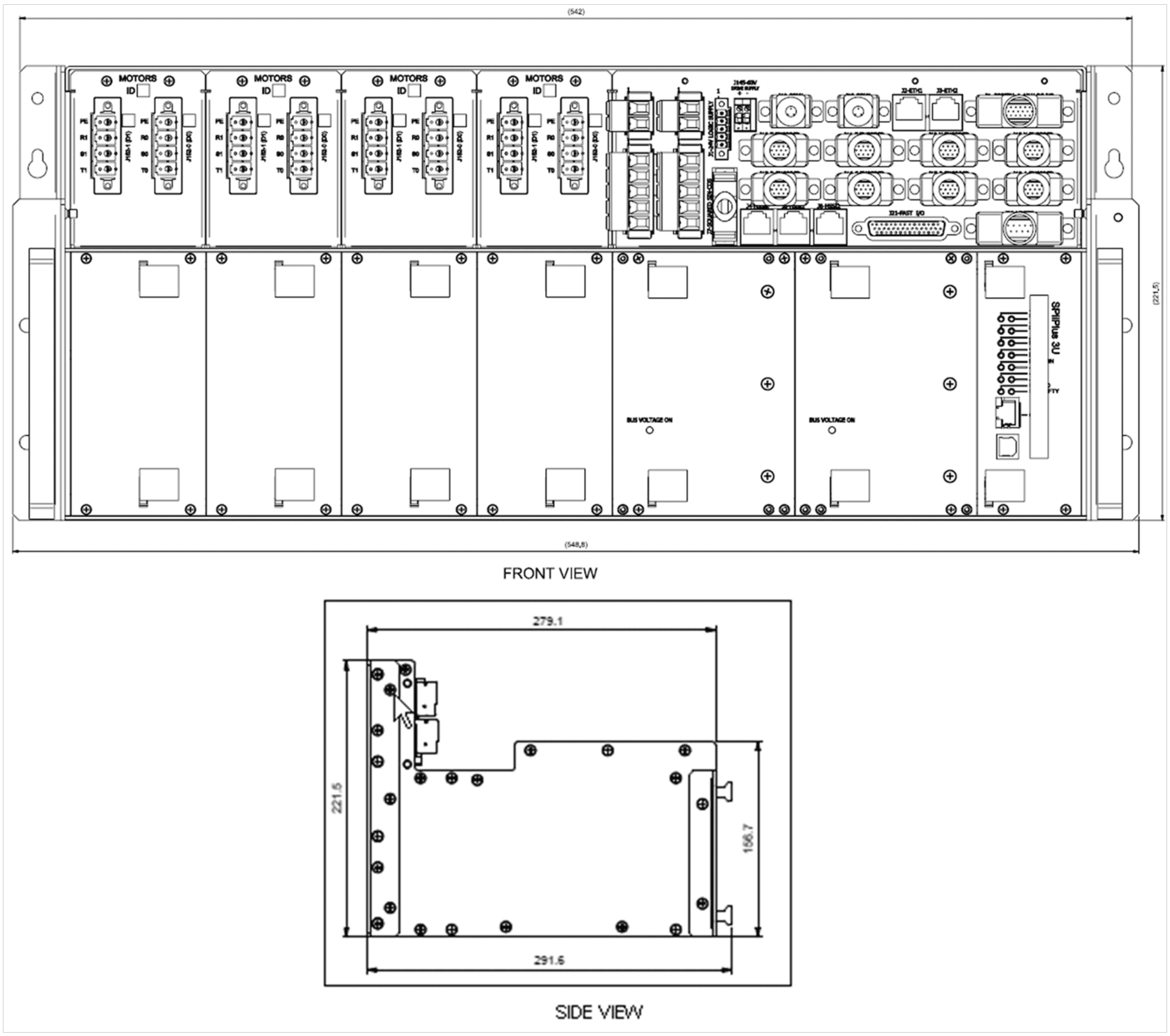


Figure 2-10. MC4U-22-Piano-enc Dimensions

2.1.5.3 Weight

The MC4U-22-Piano-enc has a maximum weight of 17 kg.

2.1.5.4 Cooling Vents

The MC4U-22-Piano-enc has four cooling vents.

Each vent provides a maximum of 120 CFM air flow for the internal cooling of the circuit boards within the mechanical housing. The cooling vents operate off the 24V logic supply. The cooling vents current consumption is 1A or less (depending on the number of vents).

For information regarding cooling vent periodical maintenance , see Maintenance.

2.2 MC4U Optional Accessories

Optional accessories for the MC4U Control Module are listed in the following table:

Table 2-6. MC4U Optional Accessories

Accessory	Description
MC4U-MF-560V	Motor filter with connectors (accessory kit included). Not available for the SPiiPlusNT/DC-NP (Rev. C).
MC4U-REGEN-600	External regeneration resistor 600W
HSSI IO16	Digital I/O expansion module with 16 Inputs and 16 Outputs
HSSI IO16-S	Digital I/O expansion module with 16 Inputs and 16 Outputs. Sink configured.
HSSI-IO16 ACC	HSSI-IO16 module accessories. Includes: -Two 20 pin I/O connectors -Two 3 pin power connectors -Five coding profiles
HSSI HUB	HSSI-HUB for up to four HSSI channels. Includes one 30 pin header flat cable
HSSI CABLE	Five meters HSSI-Cable FTP type, cat. 5

2.2.1 MC4U-MF-560V Motor Filter

The MC4U-MF-560V three-phase Motor Filter is designed for applications that are especially sensitive to electrical noise. The Motor Filter is connected in series between the amplifier and the motor. The filter attenuates the noise induced by the drive’s high current switching.

Figure 2-11. MC4U-MF-560V Motor Filter

The filter is housed in a 14cm by 12.7 cm metal enclosure, with power-in and power-out PHOENIX connectors. The filter's mechanical design provides for wall mounting.

2.2.1.1 Motor Filter Operational Specifications

The following table provides details of the Motor Filter operating parameters.

Table 2-7. Motor Filter Operational Specifications

Characteristic	Value
Maximum input continuous voltage (rms)	440Vac
Maximum input peak voltage	620V
Maximum continuous input current	20A
Maximum input peak current up to 1 second from startup	40A
Maximum output continuous voltage (rms)	440Vac
Maximum output peak voltage	620V
Maximum output continuous current	20A
Maximum output peak current up to 1 second from startup	40A
Safety and EMC approval	UL508C
Ambient operating temperatures	0 to 40^{o}C

Characteristic	Value
Storage temperatures	-25^{o} to $+60^{o}$C

2.2.1.2 J1 - Drive Connector

J1 is a Phoenix PCV 4/5-G-7,62 high current power, 5-pin, header. It is designed for a 20Arms continuous contact current and a working voltage of 400Vrms. The connector can handle a minimum of 500 couplings.

The pinout for J1 is provided in the following table:

Table 2-8. J1 - Drive Connector Pinout

Pin	Name	Description
1	T(L1_D)	Input- Driver phase
2	S(L2_D)	Input- Driver phase
3	R(L3_D)	Input- Driver phase
4	-	Not connected
5	PE(EGND)	Shield

2.2.1.3 J2 - Motor Connector

J2 is a Phoenix PC 4/4-G-7.62 high current power, 4-pin, header. It is designed for a 20Arms continuous contact current and a working voltage of 400Vrms. The connector can handle a minimum of 500 couplings.

The pinout for J2 is provided in the following table:

Table 2-9. J2 - Motor Connector Pinout

Pin	Name	Description
1	T(L1_M)	Output-Motor phase
2	S(L2_M)	Output-Motor phase
3	R(L3_M)	Output-Motor phase
4	PE(EGND)	Shield

2.2.1.4 Motor Filter Physical Specifications

The motor filter is designed for rack mounting; although, as an option, it can be wall mounted.

The following figure gives the external dimensions (in mm) of the motor filter:

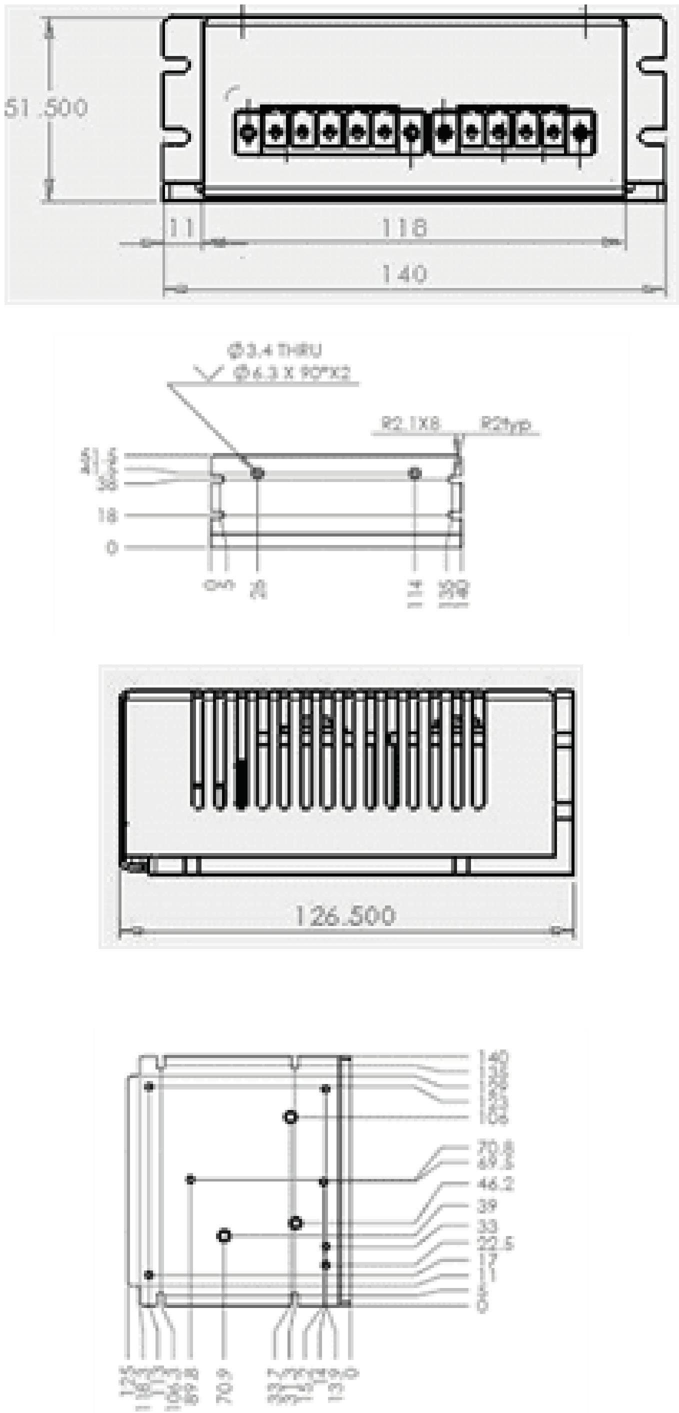


Figure 2-12. Motor Filter External Dimensions

2.2.1.5 Connecting the Motor Filter

The filter is positioned between the drive and the motor and is designed for currents up to 20A continuous, and 40A peak.

The Motor Filter should be cooled by an external fan when input current is more than 10Arms, otherwise the unit can be damaged.

When connecting the motor filter, the filter has to be located as close as possible to the amplifier. The cable connecting the filter and amplifier should be shielded. It is recommended that continuity be maintained between the shields of the two cables, and that the shield is connected to the PE terminals.

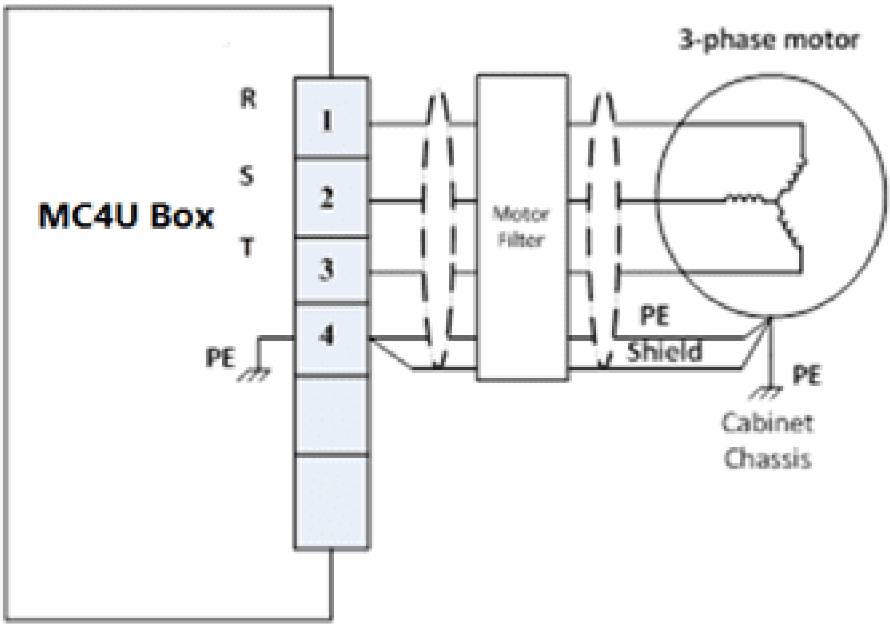


Figure 2-13. Motor filter connection diagram

2.2.2 MC4U-REGEN-600 Regeneration Module

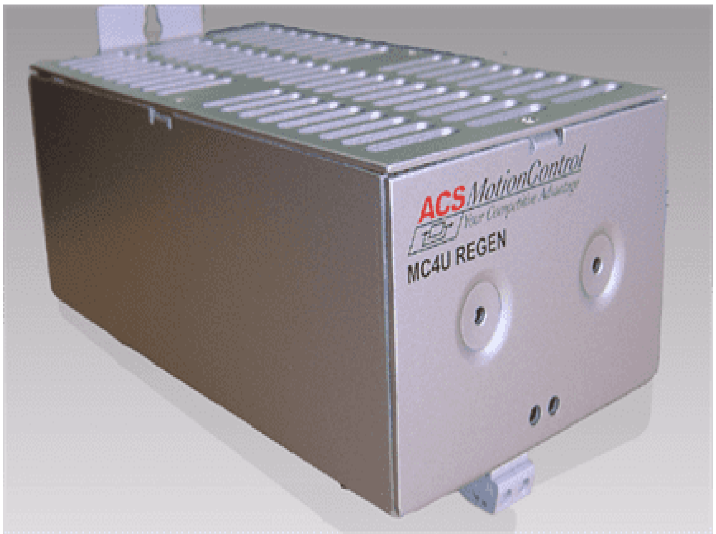


Figure 2-14. Regeneration Module

The MC4U-REGEN-600 Regeneration Module enables the user to incorporate an external regeneration resistor into the system to absorb the motor regeneration energies of more than 100W rms.

The external regeneration resistor value depends on the application. The resistance value in this module is 26Ω/600W.

For complete details of Regeneration see Motor Regeneration Circuit.

2.3 Package Contents

> MC4U control module

> STO-ACC1: STO mating connector with 2m cable (for units ordered with STO)

Figure 2-15. STO-ACC1 mating connnector with 2m cable

> Mating connectors kit according to ordering options

Table 2-10. MC4U Mating connectors kit

Mating connector kit	Description
MC4U-11IN-ACC	Mating connectors kit, MC4U 11" & 9" enclosure
MC4U-19IN-ACC	Mating connectors kit, MC4U 19" & 22" enclosure

2.4 Mounting MC4U

All MC4U enclosures may be panel-mounted.

The MC4U-19-Piano-enc and MC4U-22-Piano-enc may also be rack-mounted.

2.4.1 Panel-Mounting the MC4U

The MC4U comes with brackets installed on each side of the rear of the unit for panel-mounting. Figure 2-16 and Figure 2-17 illustrate panel mounting the MC4U-9-Piano-enc and MC4U-11-Piano-enc, and the MC4U-19-Piano-enc and MC4U-22-Piano-enc, respectively.

> When connecting the wiring, care must be taken to route the wiring from the top or sides so that there is no interference with the air flow of the vents in the top of the MC4U unit.

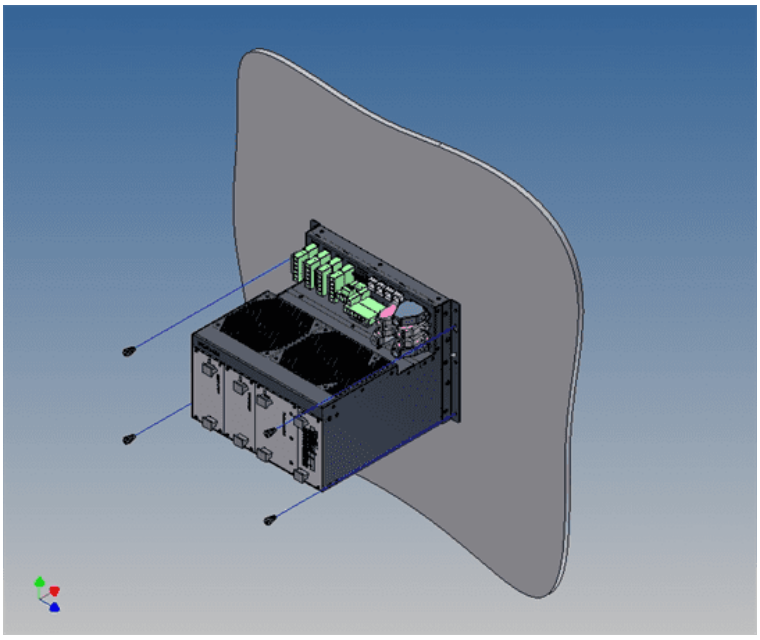


Figure 2-16. MC4U-9-Piano-enc and MC4U-11-Piano-enc Panel-Mounting

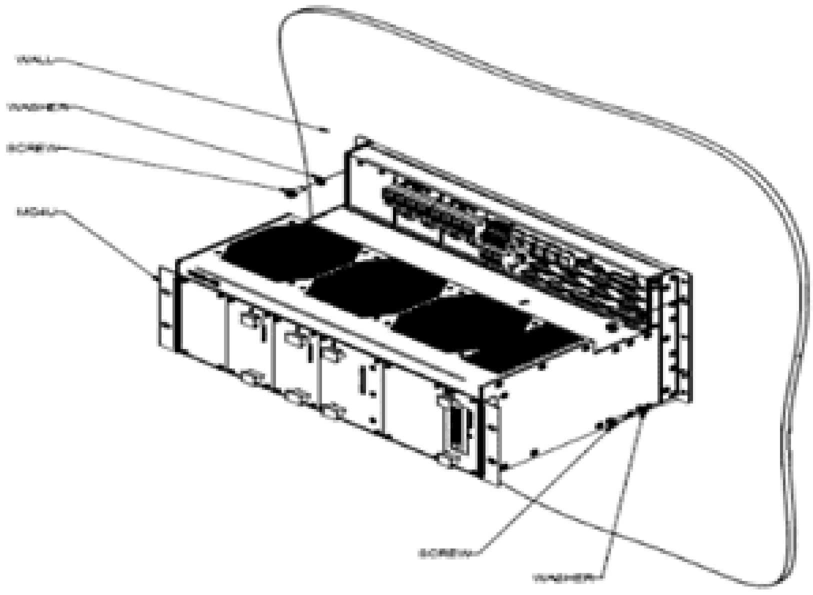


Figure 2-17. MC4U-19-Piano-enc and MC4U-22-Piano-enc Panel-Mounting

2.4.2 Rack-Mounting the MC4U-19-Piano-enc and MC4U-22-Piano-enc

The MC4U-19-Piano-enc and MC4U-22-Piano-enc may be mounted in a rack with a shelf width of 45 cm.The following figure illustrates the hardware needed and how the unit is mounted.

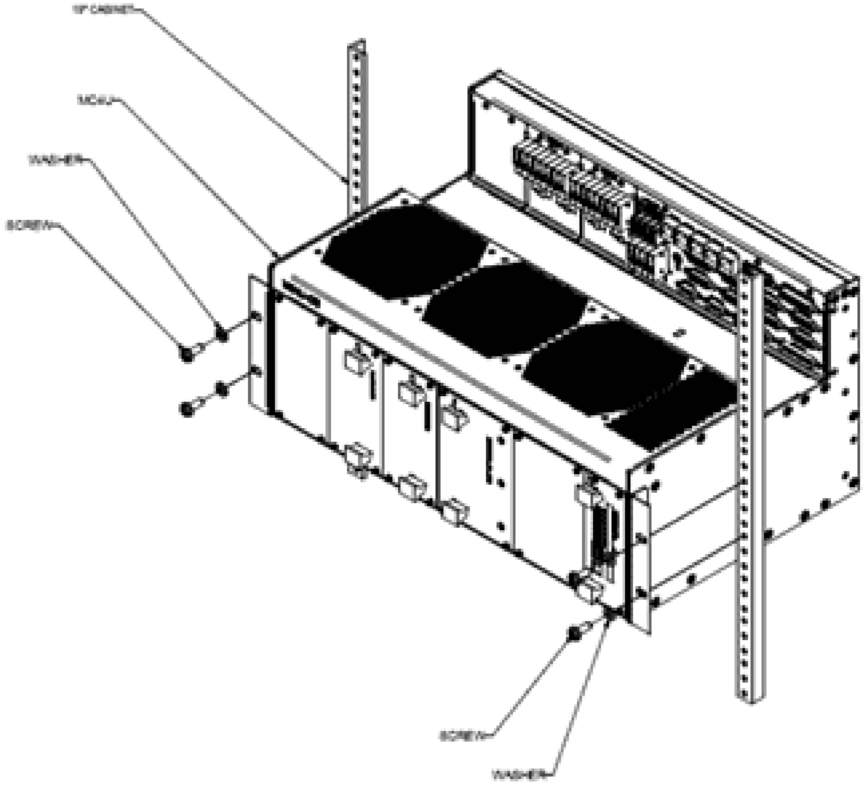


Figure 2-18. MC4U-19-Piano-enc and MC4U-22-Piano-enc Rack Mount

> There is an option for adding Schroff P/N 10501-006 handles to the front brackets to facilitate maneuvering the MC4U-19-Piano-enc and MC4U-22-Piano-enc.

2.5 Safe Torque Off (STO)

> STO is an optional feature.
> The STO circuit functionality is designed and tested by ACS to comply with the requirements of EN ISO 13849-1, EN 62061, and IEC 61800-5-2 standards.
> STO Cable Mating kit (PN STO-ACC1), provides a cable with flying leads used to connect the optional STO module.

STO (The Safe Torque Off) is the fundamental safety capability needed in order to prevent moving of motors upon a safety event.

STO capability prevents the moving of the motor using two hardware inputs, STO1 and STO2 that block the PWM signals to the power stage of the drive. A 24V (18Vdc to 33Vdc) must be connected to both inputs to enable the drive's regular operation. When the 24V is removed from one or both STO inputs, the PWM signals are blocked at least 50msec afterwards but not more than 200msec afterwards. In addition, the controller is informed about this event. This delay (between informing the controller and blocking of the PWM signals of the drive) provides the controller the ability to bring all axes to a complete stop (or low velocity movement) in an orderly manner. The implementation of the STO guarantees that under any foreseen circumstances, failure or damage, any of following types of motors will not move:

- AC synchronous (DC brushless)
- Step motor
- AC asynchronous (AC induction)

For DC brush motor, removing the 24V from both STO inputs, guarantees that under any foreseen circumstances, failure or damage, the motor will not move.

Usually, STO1 and STO2 are connected to a 24V source via industry standard safety switch. This device disconnects the 24V upon opening a door, a light current tripping or other safety related event.

> In MC4U control modules, STO1 and STO2 signals reach the drives but no signal indicating the status of the STO inputs are connected to the motion controller. To be able to activate default response to STO fault in MC4U, The STO inputs of at least one drive should be connected to any of the 8 general purpose digital inputs. Ver. 2.30 allows routing STO inputs to any two of the 8 MC4U inputs. See *SPiiPlus ADK Suite v2.30 Release Notes*.

The following figure describes a wiring scheme of a safety relay, controlled in this example by a PLC safety device.

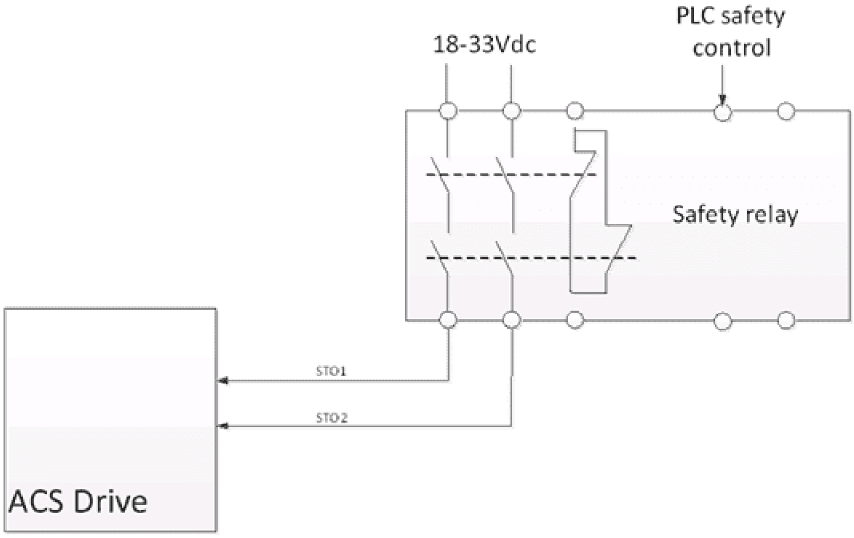


Figure 2-19. STO Wiring Scheme

The STO inputs can be also fed from a door switch, a light-curtain or any other safety related controller.

The following figure describes a schematic STO implementation: The STO inputs feed the power (through additional circuitry which is not shown in the figure) to the upper and lower PWM drivers of the corresponding transistors

The STO circuit is implemented on a dedicated module that plugs into all ACS products that support this functionality.

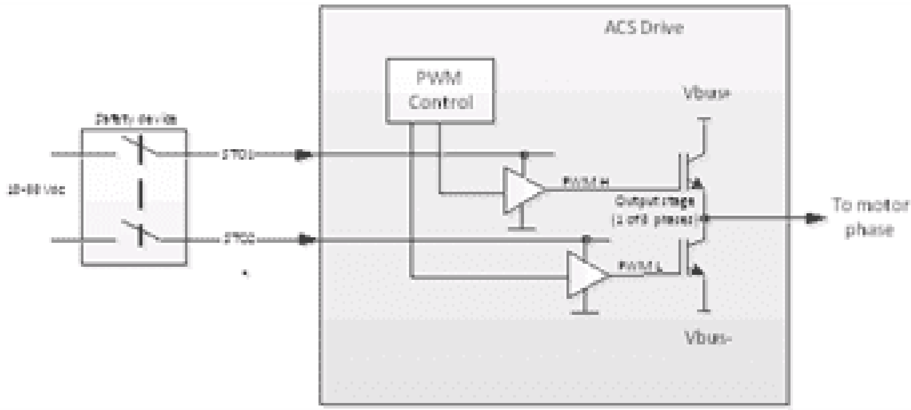


Figure 2-20. STO Implementation

2.5.1 STO Module Connector Type and Pinout

MC4U drive modules with the STO option have the STO connector located on the front of the drive module.

Figure 2-21. Drive module with STO option

Table 2-11. STO Connector Type

Connector Name	STO Input
Connector type	JST 5 PIN 2mm male SM05B-PASS-1
Mating connector type	JST 5 PIN 2mm female PAP-05V-S Pin: SPHD-001T-P0.5

Table 2-12. STO Pinout

Pin	Name	Description
1	STO1-	Safety torque input 1 inverted input
2	STO1+	Safety torque input 1 non inverted input
3	EGND	Electrical ground
4	STO2+	Safety torque input 2 non inverted input
5	STO2-	Safety torque input 2 inverted input

2.6 Secondary EtherCAT Port

MC4U controller modules with SPiiPllusNT/DC Rev D have the secondary EtherCAT port connector (J3) located on the front of the controller module.

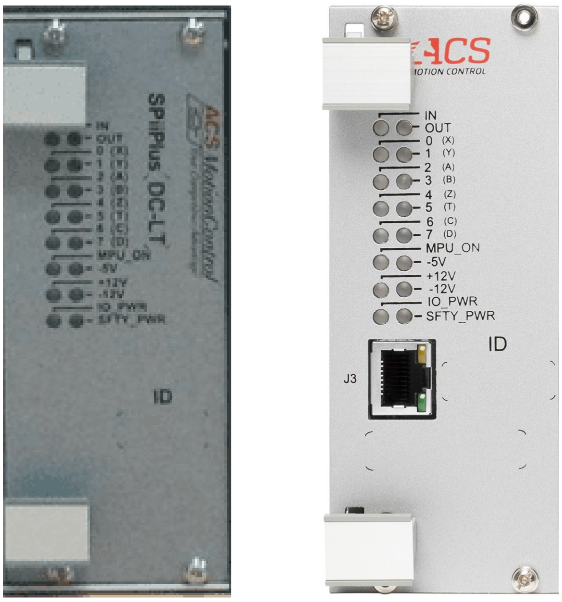


Figure 2-22. Control module without and with the secondary EtherCAT port

2.7 Spare part installation

The MC4U is designed for the easy swapping out any of the component (SPiiPlus controller, PSM3U power supplies, DDM3U motor drives).

> Before replacing any MC4U module, disconnect all power and cables and wait for all voltages to discharge. A waiting period of 30 minutes must be strictly observed.

To replace an MC4U module:

1. Make sure that no power is being applied to the unit and that all voltages have discharged.
2. Remove the MC4U unit from the machine.
3. Remove the four retaining screws located in the four corners of the module.
4. Push the upper extractor knob up while pushing the bottom extractor down and firmly pull the module out.
5. Insert the new module being careful to align the module card on the red guiderail and gently push the component straight in (using the two knobs) until the component is well seated in the motherboard.
6. Reinstall the four retaining screws.
7. Reinstall the MC4U into the machine.
8. Reconnect all cables.

2.8 Maintenance

In order to improve the MC4U MTBF it is recommended that the cooling vent fans be replaced after 33,000 hours of operation.

Contact ACS for fan replacement instructions.

3. Modules

This section provides detailed specifications of the MC4U family and its components. The components consist of:

- SPiiPlusNT/DC Motion Controller(s)
  - SPiiPlusNT/DC Rev. FA configurations
- PSM3U Power Supply
  - PSM3U-28V-0.5kW Power Supply
  - PSM3U-48V-XXkW Power Supply
  - PSM3U-320V-4kW Power Supply
  - PSM3U-320V-8kW Power Supply
  - PSM3U-320V-10kW Power Supply
  - PSM3U-320V-11kW Power Supply
  - PSM3U-320/48V-0.7/8kW Power Supply
  - PSM3U-320V-20KW Power Supply
  - PSM3U-560V-7kW Power Supply
  - PSM3U-100V-3kW Power Supply
- Motor Drive (up to a maximum of 3 units)
  - PWM Drives
  - Nano PWM Drives
  - LDM3U Single Axis Linear Drive

The functionality of any specific MC4U Control Module is determined by the motherboard that is installed. See MC4U Motherboards for details of the various motherboards incorporated in the MC4U Control Module models.

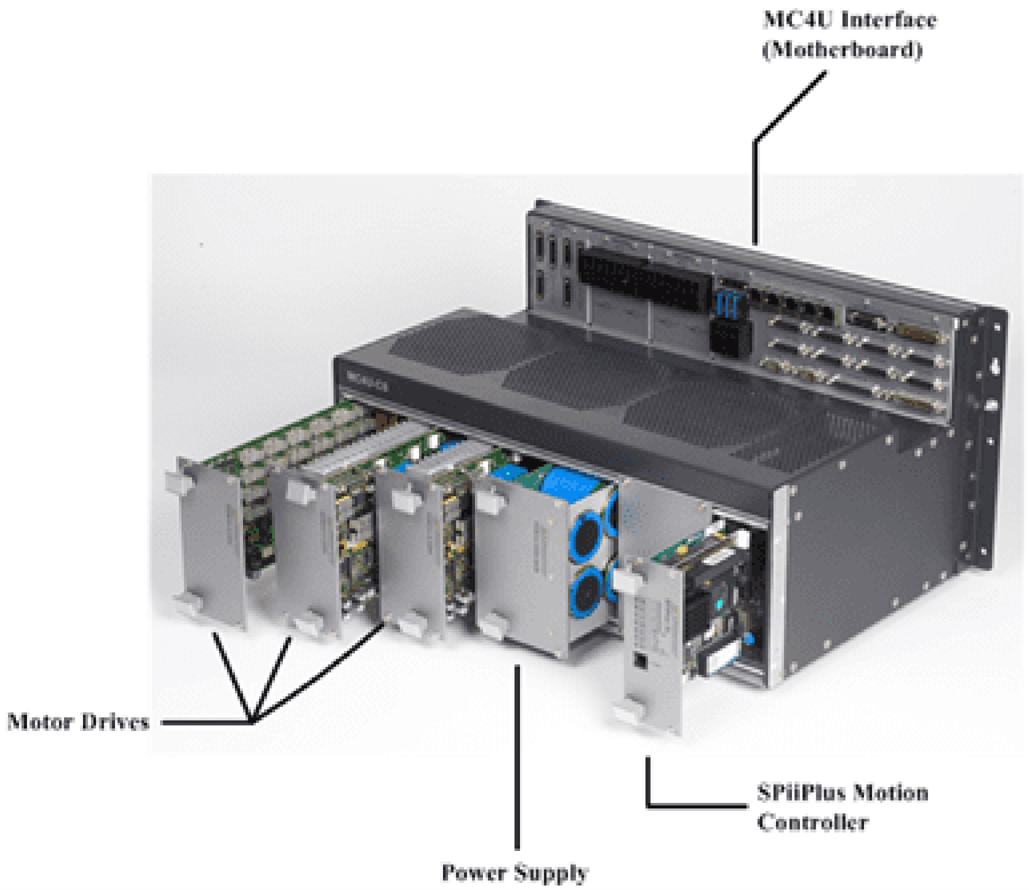


Figure 3-1. MC4U Components

3.1 SPiiPlusNT/DC Motion Controllers

This section provides technical details of the SPiiPlusNT/DC motion controllers. For complete details, refer to the relevant SPiiPlusNT/DC Motion Controller Hardware Guide.

3.1.1 SPiiPlusNT/DC Rev. FA configurations

The SPiiPlusNT/DC is available in the following configurations:

> SPiiPlusNT-LT/HP/LD

> SPiiPlusDC-LT/HP/LD

The minimum SPiiPlusNT/DC-LT/HP/LD hardware revision is FA and SPiiPlusNT-SC FW v2.29.04.00.

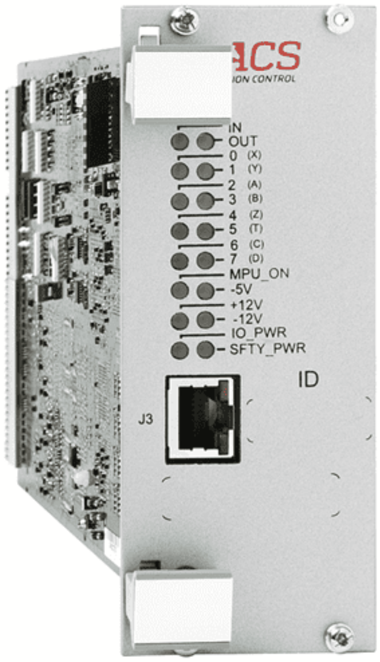


Figure 3-2. SPiiPlusNT Rev. D General View

The SPiiPlusNT and SPiiPlus DC controllers differ by their networking capabilities:

> The SPiiPlusNT serves as a network master: in addition to its regular control of the SPiiPlusNT/DC axes, it supports an EtherCAT port and the control software required to expand the network. Network expansion is provided by the addition of network elements such as other MC4Us (which contain a SPiiPlusDC controller), UDMnt, PDMnt, SDMnt and others.

> The SPiiPlusDC serves as a slave controller in a EtherCAT network, serving the local SPiiPlusNT/DC axes. In this slave role, the SPiiPlusNT/DC is a network element, being part of larger network whereby a master SPiiPlusNT/DC (containing a SPiiPlusNT controller) or an NTM controls the overall network. The SPiiPlusDC has an incoming port from a previous network element from which it receives the profiles and commands intended for its axes, and outgoing port to connect the next network element (if exists) and maintain the communication network.
The SPiiPlusDC is physically similar to the SPiiPlusNT, except that it does not have an MPU board and does not include EtherCAT connector J3.

A network must contain one master and can have any number of slaves.

Both motion controller versions have the following features:

> Supports NanoPWM™ technology drives and up four axes.

> Controller - the servo control algorithm executes at an uncompromising rate of 20kHz for each axis regardless of the number of axes, providing very large bandwidth, exceptional dynamic tracking, fast settling, and excellent smoothness at low velocities.

The controller is manufactured under ISO 9001 certified quality management system, meeting stringent safety and EMC standards and is CE marked.

- Communication Channels - communication with the controller through all channels can be done simultaneously:
  - The controller communicates with a computer host via an RS-232 serial channel or Ethernet 100/1000 BaseT channel.
  - In addition it can communicate with other computers via a second RS-232 serial channel (115,200 baud) or Ethernet 100/1000 BaseT channel.
  - The SPiiPlusNT and SPiiPlusDC have 1/2 EtherCAT channels, operating at 100Mbs. The EtherCAT connectors are located on the controllers front panel.
- Discrete Interface Signals - the controllers come with digital and analog I/Os used for general purpose and for functional and dedicated purposes. These signals are accessible to the user from the MC4U's connector panel only. In addition, digital inputs can be used for hardware-based position registration and outputs can be used to trigger position-based events with sub-µSec delay accuracy.

> Configuration of the digital I/Os are by jumpers on the SPiiPlusNT/DC controller. See SPiiPlusNT/DC Jumpers for a general list and the *SPiiPlusNT/DC Motion Controller Hardware Guide* for detailed information.

- ACSPL+ - complex applications are easy to develop with ACSPL+, a powerful, true multitasking, high-level language that is optimized for motion control applications. Ten programs can run simultaneously, enabling multiple interacting and synchronized processes. ACSPL+ enables implementation of highly complex motion-time-event sequences with accurate positioning and timing. The program can run directly on the controller or can be implemented in a host PC application using libraries provided for C, C++, COM, and .NET.
- Suite of Tools - powerful software tools are provided for setup, tuning, and programming. Application development is particularly easy with the integrated four-channel soft scope and multi-axis motion simulator.

The SPiiPlusNT/DC controllers are available in the following models:

- High Performance Controllers:
  - SPiiPlusNT/DC-HP - a high performance drive controller with 16-bit A2D for motor current and analog SIN-COS encoder measurements.
  - SPiiPlusNT/DC-LD - a high performance drive controller based on the SPiiPlusNT/DC-HP with an additional module for 16-bit analog commands to linear drives.
  - SPiiPlusNT/DC-NP - a high performance ***Nano****PWM*™ drive controller
- Light Controllers
  - SPiiPlusNT/DC- LT - an economical drive controller that uses 12-bit A2D for motor current and analog SIN-COS encoder measurements.

3.1.1.1 SPiiPlusNT/DC Motion Controllers Rev. FA Features

The SPiiPlusNT/DC-LT/HP/LD/NP features are described in the following tables:

The values are for a SPiiPlusNT system with additional slave drives, including MC4U slave drives with SPiiPlusDC controllers.

Table 3-1. CTIME Values for MC4UNT SPiiPlusNT-LT/HP/LD/NP, SPiiPlusSANT (Rev. G and later) Controller

Controller (to be inserted into MC4UNT)	Number of Built-in Drives	Maximum Number of Axes	Default Number of Available ACSPL+ Buffers**	Maximum Number of Simultaneously Running		Controller Cycle Time					ServoBoost Supported
				Motors	ACSPL+ Buffers	1 (msec) 2 (msec)	0.50 (msec)***	0.25 (msec)*	0.20 (msec)*	Default Value (msec)	
SPiiPlus NT-LT-4	4	4	10	4	10	√ [2,3]	-	-	-	1	-
SPiiPlus NT-LT-4	4	8	10	8	10	√ [2,3]	-	-	-	1	-
SPiiPlus NT-LT-4	4	16	16	16	16	√ [2,3]	-	-	-	1	-
SPiiPlus NT-LT-4	4	32	32	32	32	√ [2,3]	-	-	-	1	-
SPiiPlus NT-LT-4	4	64	64	64	64	√ [2,3]	-	-	-	1	-
SPiiPlus NT-LT-8	8	8	10	8	10	√ [2,3]	-	-	-	1	-
SPiiPlus NT-LT-8	8	16	16	16	16	√ [2,3]	-	-	-	1	-
SPiiPlus NT-LT-8	8	32	32	32	32	√ [2,3]	-	-	-	1	-
SPiiPlus NT-LT-8	8	64	64	64	64	√ [2,3]	-	-	-	1	-
SPiiPlus NT-HP-4 / NT-LD-4 / NT-NP-2	4	4	10	4	10	√ [2,3]	√ [2,3,4]	√ [2,3,4]	√ [2,3,4]	0.5	√
SPiiPlus NT-HP-4 / NT-LD-4 / NT-NP-2	4	8	10	8	10	√ [2,3]	√ [2,3,4]	√ [2,3,4]	√ [1,3,4]	0.5	√
SPiiPlus NT-HP-4 / NT-LD-4 / NT-NP-2	4	16	16	16	16	√ [2,3]	√ [2,3,4]	√ [2,3,4]	-	0.5	√
SPiiPlus NT-HP-4 / NT-LD-4 / NT-NP-2	4	32	32	32	32	√ [2,3]	√ [2,3,4]	√ [2,3,4]	-	0.5	√
SPiiPlus NT-HP-4 / NT-LD-4 / NT-NP-2	4	64	64	64	64	√ [2,3]	√ [2,3,4]	-	-	1	√
SPiiPlus NT-HP-8 / NT-LD-8 / NT-NP-4	8	8	10	8	10	√ [2,3]	√ [2,3,4]	√ [2,3,4]	√ [1,3,4]	0.5	√
SPiiPlus NT-HP-8 / NT-LD-8 / NT-NP-4	8	16	16	16	16	√ [2,3]	√ [2,3,4]	√ [2,3,4]	-	0.5	√
SPiiPlus NT-HP-8 / NT-LD-8 / NT-NP-4	8	32	32	32	32	√ [2,3]	√ [2,3,4]	√ [2,3,4]	-	0.5	√
SPiiPlus NT-HP-8 / NT-LD-8 / NT-NP-4	8	64	64	64	64	√ [2,3]	√ [2,3,4]	-	-	1	√

(1) 2-axes Extended Segmented Motion (XSEG) with limitations: a. Segment length > 5 ms, b. IMM VEL = … command shouldn't be used
(2) 6-axes Extended Segmented Motion (XSEG) with limitation: Segment length > 1 ms. The user's responsibility is to ensure that the USAGE doesn't exceed 80%.
(3) NetworkBoost (Ring Topology) with limitations: a. CTIME = 1 msec - up to 64 axes b. CTIME = 0.50 msec - up to 24 axes c. CTIME = 0.25 msec - up to 8 axes d. CTIME = 0.20 msec - up to 4 axes
(4) BPTP/2 command limited to 4 axes or less

*Supported ordering option.
**Up to 64 buffers supported with ordering option.
*** 64 axes with Controller Cycle Time 0.50 (msec) supported with ordering option

Table 3-2. SPiiPlusNT/DC-LT/HP/LD/NP Additional Features

HW Feature	SPiiPlusNT/DC-LT/HP/LD/NP	Remarks
Profile Generation		
Motion Profile generation rate	1, 2, 4 or 5kHz	
Feedback		
Incremental Digital Encoder	One per axis: A&B,I; UP/DN,I; CLK/DIR,I. Type: RS-422 Max. rate: 40 million encoder counts/sec.	
Sin-Cos Encoder (optional)	One per axis SPiiPlusNT/DC-HP/LD/NP: Multiplication factor: From x4 to x65,536. Rate: HP/NP version: Up to $500*10^3$ sine periods/sec; LD version: $4*10^6$ sine periods/sec. Sin-Cos offset, gain, phase compensation: programmable with automatic calibration. Offset is hardware compensated, +/-50% of signal range. Maximum acceleration: 4×10^8 sine periods/sec^2. SPiiPlusNT/DC-LT: Multiplication factor: From x4 to x4,096 Sin-Cos offset gain, phase compensation: programmable with automatic calibration. Rate: $250*10^3$ sine periods/sec. Maximum acceleration: 4×10^8 sine periods/sec^2.	
Hall inputs	Set of three per axis. Single-ended, 5V, source, opto-isolated. Input circuit current: <7mA.	

HW Feature	SPiiPlusNT/DC-LT/HP/LD/NP	Remarks
Absolute encoder	Supports EnDat 2.1/2.2 (Digital only), Smart-ABS, Panasonic, Biss-C, SSI, Hiperface, Sanyo Danki. Indices: X(0), Y(1), (Z(4) and T(5).	
Drive Interface		
Analog commands (SPiiPlusNT/DC-LD only):	Two phases per axis. Type: ±10V,differential, 16 bit resolution. Offset compensation: programmable, 0.3mV resolution.	Drive command analog outputs are supported only by the SPiiPlusNT/DC-LD product.
PWM drive commands	Three phases per axis. Control algorithm: digital PI filters with field oriented control and space vector modulation. PWM frequency: 40kHz on the motor.	
Drive Current Feedback	Two phases per axis. Current loop sampling rate: 20kHz. Current feedback resolution: SPiiPlusNT/DC-HP/LD/NP: 16 bit. SPiiPlusNT/DC-LT: 12 bit.	
External drives	SPiiPlusNT/DC-LD: two phases per axis	Supported only by following motherboards: MB5U-Z MB5U-YYYY MB5U-ZZZ MB5U-ZZW
Digital I/O		
Safety Inputs:		
Emergency stop input	One per controller. Type: two-terminal, sink or source, opto-isolated.	

HW Feature	SPiiPlusNT/DC-LT/HP/LD/NP	Remarks
Left and right limit inputs	One pair per axis. Type: single-ended, sink (default) or source, configurable by jumper, opto-isolated. Supply: 5V or 24V. Input current: <15mA.	
Digital Inputs:		
General Purpose Inputs	Eight. Type: single-ended, 5V or 24V, sink (default) or source, opto-isolated. Input current: <15mA.	
MARK (position capture) inputs	Up to four. Type: RS-422. Propagation delay: <0.1 µsec.	Four additional MARK inputs (MARK2), single-ended and opto-isolated, are available through general purpose digital inputs IN4, IN5, IN6 and IN7 Refer to *PEG and MARK Operations Application Notes* for detailed information.
Digital Outputs		
General purpose outputs	Eight. Type: single-ended, 5V or 24V, sink (default) or source, opto-isolated. Output current: 100mA per output.	Depends on controller configuration. Dual usage, can be used as Mechanical Brake.
Mechanical Brake Outputs:	One per axis. Type: single-ended, 5V, source only, opto-isolated Output current: 7mA per output.	Default configuration is dynamic brake.

HW Feature	SPiiPlusNT/DC-LT/HP/LD/NP	Remarks
General purpose digital outputs can be configured as Mechanical Brake Outputs. Dynamic brake signal is available only for internalSPiiPlusNT/DC drivers and is not accessible as an external signal.		
PEG pulse outputs:	Six. Type: RS-422. Propagation delay: <0.1µsec. PEG pulse width: 25nsec to 1.7msec. PEG position accuracy: ±1 count at speeds up to 18x10^6 counts/sec.	Refer to *PEG and MARK Operations Application Notes* for detailed information.
PEG state outputs	Up to six. Type: RS-422. Propagation delay: <0.1µsec.	Refer to *PEG and MARK Operations Application Notes* for detailed information.
HSSI Expansion Channels	Up to three. Each channel provides 64 input bits and 64 output bits per channel, sampled and updated every 50µsec. Type: RS-422.	
Analog I/O		
Analog Inputs	Up to 16. Type: 1Vptp, differential. Resolution and SNR: SPiiPlusNT-HP/LD/NP: 16 bit, SNR>72db. SPiiPlusNT-LT: 12 bit, SNR>52db.	Unused Sin-Cos encoder inputs can be used as general purpose analog inputs.

HW Feature	SPiiPlusNT/DC-LT/HP/LD/NP	Remarks
General Purpose Inputs	SPiiPlusNT-HP/LD/NP: Four dedicated general purpose inputs. Type: ±10V, differential. Resolution: 16 bits. SPiiPlusNT-LT: Up to four (when axes number 3 and/ or 7 Sin-Cos encoders are not used. Type: ±10V,differential. Resolution: 12 bits.	
General Purpose Outputs	2, 4. Type: ±10V, PWM filtered. Resolution: 10bit.	
Communication Channels		
Serial	SPiiPlusNT only: Two. RS-232. Up to 115,200bps	
Ethernet	SPiiPlusNT only: One. TCP/IP, 100/1000 Mbits/sec.	SPiiPlusNT only: Simultaneous communication through all channels is fully supported. Modbus protocol as master or slave is supported via all channels
EtherCAT	SPiiPlusNT: One or two master ports. SPiiPlusDC: One input, one output.	SPiiPlusNT only: Optional network failure detection and recovery with ring topology.
MPU (SPiiPlusNT only)		
Processor	Intel® Atom™ N2600 1.6 GHz	
Memory	RAM: 1GB Flash NV memory: 1GB	
Powerup Time	25-100 sec. according to system and network configuration	
Environment & Standards		

HW Feature	SPiiPlusNT/DC-LT/HP/LD/NP	Remarks
Operating Temperature	0˚C to 55˚C	
Storage Temperature	40˚C to 70˚C	
Humidity	90%RH, non-condensing	
Standards	CE (EMC), UL certified and RoHS compliant	

3.1.2 SPiiPlusNT/DC Indicators

The indicators are located on the front panel of the module and indicate the status of the power supplies and axes as shown in the example given in Figure 3-3.

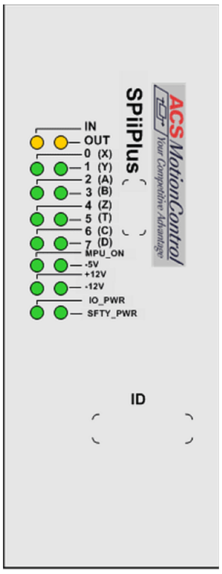


Figure 3-3. SPiiPlusNT/DC Indicators (SPiiPlusNT shown)

The indicators are detailed in Table 3-3.

Table 3-3. SPiiPlusNT/DC Indicators

Label	Description	Remarks
IN OUT	EtherCAT status Two yellow LEDs: > On: Link connected 100MHz speed > Blink: transmitter is active > Off: not connected	
Axis# (Axis)	Axis Status Four - one for each axis Bicolor (Green/Red) LEDs: > Green On: axis enabled > Red On: axis failed > Off: axis disabled	
MPU_ON	MPU Status Bicolor (Green/Red) LED > Red LED >> On: Communication fault > Green LED >> On: Control Unit functioning properly >> Blink: Processor and communications functioning properly >> Off: No connection with MPU	
-5V	-5V Status Green LED > On: -5V available > Off: No -5V	
+12V	+12V Status Green LED > On: +12V available > Off: No +12V	
-12V	-12V Status	

Label	Description	Remarks
	> Green LED > On: -12V available Off: No -12V	
IO_PWR	I/O Power Status Green LED > On: voltage is available > Off: No voltage	
SFTY_ PWR	Safety Power Status Green LED > On: voltage is available > Off: No voltage	
J3	Two LEDs: Green and Yellow Green LED > On: Link present > Blink: Link active Yellow LED > ON: communication at 100MHz	SPiiPlusNT-LT/HP/LD Rev D and later only.

3.1.3 SPiiPlusNT/DC Jumpers

Different jumper settings affect the following:

- Safety inputs in sink and source configuration
- Digital outputs in sink and source configuration
- Digital inputs in sink and source configuration.

Table 3-4 lists the SPiiPlusNT/DC jumpers, their functions, and, where relevant, their settings:

Table 3-4. SPiiPlusNT/DC Jumpers and Setting

Jumper	Function	Jumper Settings
JP1	Safety inputs in sink and source	Position 1,2 - sink Position 2,3 - source Default: sink
JP2	Digital outputs in sink and source	Position 1,2 - sink Position 2,3 - source Default: sink

Jumper	Function	Jumper Settings
JP3	Digital inputs in sink and source	Position 1,2 - sink Position 2,3 - source Default: sink
JP7	I^2C slave device EEPROM data protection.	Installed - Data protected Uninstalled - Data not protected Default: Data protected

3.2 PSM3U Power Supplies

The PSM3U line of power supplies generates all drive and control voltages for a MC4U system. These power supplies must be matched to the motherboard installed in the MC4U Control Module (see PSM3U Power Supplies - General). All power supplies need two input voltage supplies:

> The 24Vdc input power supply should not be connected to a DC distribution network; an external AC/DC supply with a 24Vdc, 5A output must be used.

> Whenever any MC4U maintenance has to be performed and a PSM3U-48V-xx power supply is installed, after disconnecting the unit from external power, a waiting period of 30 minutes must be observed in order to allow complete voltage discharge before disassembling any of the MC4U components. Otherwise damage could occur to the unit.

Table 3-5. PSM3U Power Supplies - General

Power Supply	Applicable Motherboard	Applicable Controller
PSM3U-28V-0.5kW	MB5U-CONT-PS MB5U-YYYY MB5U-ZZZ MB5U-ZV MB5U-ZZ	SPiiPlusNT/DC Rev. B SPiiPlusNT/DC Rev. D
PSM3U-48V-0.7kW	MB5U-CONT-PS MB5U-YYYY MB5U-ZZZ MB5U-ZVM B5U-ZZ	SPiiPlusNT/DC Rev. B SPiiPlusNT/DC Rev. D

Power Supply	Applicable Motherboard	Applicable Controller
PSM3U-48V-1.4KW	MB5U-CONT-PS MB5U-ZZW MB5U-ZV MB5U-ZZ	SPiiPlusNT/DC Rev. B SPiiPlusNT/DC Rev. D
PSM3U-320V-4KW	MB5U-CONT-PS MB5U-CONT-PS2 MB5U-Z MB5U-ZV MB5U-ZZ MB5U-YYYY MB5U-ZZZ MB5U-ZZW	SPiiPlusNT/DC Rev. B SPiiPlusNT/DC-NP (Rev. C) SPiiPlusNT/DC Rev. D
		SPiiPlusNT/DC Rev. B SPiiPlusNT/DC-NP (Rev. C) SPiiPlusNT/DC Rev. D
PSM3U-320V-8kW	MB5U-CONT-PS MB5U-CONT-PS2 MB5U-Z MB5U-ZV MB5U-ZZ MB5U-YYYY MB5U-ZZZ MB5U-ZZW	SPiiPlusNT/DC Rev. B SPiiPlusNT/DC (Rev. C) SPiiPlusNT/DC Rev. D
		SPiiPlusNT/DCRev. B SPiiPlusNT/DC-NP (Rev. C) SPiiPlusNT/DC Rev. D
PSM3U-320V-10kW	MB5U-CONT-PS MB5U-CONT-PS2 MB5U-Z MB5U-ZV MB5U-ZZ MB5U-YYYY MB5U-ZZZ MB5U-ZZW	SPiiPlusNT/DC Rev. B SPiiPlusNT/DC-NP (Rev. C) SPiiPlusNT/DC Rev. D
		SPiiPlusNT/DC Rev. B SPiiPlusNT/DC-NP (Rev. C) SPiiPlusNT/DC Rev. D
PSM3U-320V-11kW	MB5U-CONT-PS MB5U-Z	SPiiPlusNT/DC Rev. B SPiiPlusNT/DC-NP (Rev. C) SPiiPlusNT/DC Rev. D
		SPiiPlusNT/DC Rev. B SPiiPlusNT/DC-NP (Rev. C) SPiiPlusNT/DC Rev. D

Power Supply	Applicable Motherboard	Applicable Controller
PSM3U-320/48V-0.7/8kW	MB5U-CONT-PS MB5U-ZZW MB4U-ZZW-AX7	SPiiPlusNT/DC Rev. B SPiiPlusNT/DC Rev. D
		SPiiPlusNT/DC Rev. B SPiiPlusNT/DC Rev. D
PSM3U-320V-20kW		SPiiPlusNT/DC Rev. B SPiiPlusNT/DC-NP (Rev. C) SPiiPlusNT/DC Rev. D
		SPiiPlusNT/DC Rev. B SPiiPlusNT/DC-NP (Rev. C) SPiiPlusNT/DC Rev. D
PSM3U-560V-7kW	MB5U-CONT-PS MB5U-YYYY MB5U-ZZZ MB5U-ZV MB5U-ZZ	SPiiPlusNT/DC Rev. B SPiiPlusNT/DC Rev. D
PSM3U-100V-3kW		SPiiPlusNT/DC Rev. B SPiiPlusNT/DC-NP (Rev. C) SPiiPlusNT/DC Rev. D
		SPiiPlusNT/DC Rev. B SPiiPlusNT/DC-NP (Rev. C) SPiiPlusNT/DC Rev. D

3.2.1 PSM3U Specifications

3.2.1.1 PSM3U-28V-0.5kW Power Supply

The following lists the PSM3U-28V-0.5kW specifications.

Parameter	Description
Certification Type	CE / UL
Input Voltage [Vac] range	> Single phase: 85-265

Parameter	Description
	> Three phase: 230±10%
Input Voltage [Vdc]	120-375
Input frequency, nominal [Hz]	50-60
Drive bus voltage(s) at nominal load [Vdc] - @110Vac 1 phase / 230Vac 1 phase	28
Output power, cont. (nomical load) [kW] - @110Vac 1 phase / 230Vac 1 phase	0.5
Output power, peak for 1 second. (peak load) [kW] - @110Vac 1 phase / 230Vac 1 phase	0.5
Output current, cont [A] - @110Vac 1 phase / 230Vac 1 phase	18
Output current, peak for 1 second [A] - @110Vac 1 phase / 230Vac 1 phase	18
Input current at nominal load [Arms]	> @110Vac 1 phase input - 6.2 > @320Vac 3 phase input - 3.2
Input current at peak load [Arms]	> @110Vac 1 phase input - 6.2 > @320Vac 3 phase input - 3.2
Input power at nominal load [kW] - @110Vac 1 phase / 230Vac 1 phase	0.6
Input power at peak load [kW] - @110Vac 1 phase / 230Vac 1 phase	0.6
Efficiency - @110Vac 1 phase / 230Vac 1 phase	81%
Power Supply Dissipation at nomial load [W] - @110Vac 1 phase	180W
Dimensions; Height, Width, Length [mm]	129 x 91 x 242
Weight [gram]	1,270

Parameter	Description
Power supply protection types	> Power supply missing > Temperature too high > Over current protection > Over voltage protection

3.2.1.2 PSM3U-48V-XXkW Power Supply

The following is a brief description of the PSM3U-48V-XXkW power supply:

Power Supply	Number of Input Phases	Nominal Input Voltage Range [Vrms] -15% +10%	Max Cont. Input Current Per Phase [Arms]	Max Cont. Input Power [W]
PSM3U-48V-0.7kW	1	100 - 240 phase to neutral	3.1	900
PSM3U-48V-1.4KW	1	100 - 240 phase to neutral	6.2	1800

PSM3U-48V-0.7kW

The PSM3U-48V-0.7kW is a low-power, regulated power supply and supplies:

- One 51Vdc nominal BUS voltage, up to 700W (motor supply), providing power for motor drivers such as DDM3U-4 drive and the like. (If 700W is not enough power, use the PSM3U-48V-1.4kW power supply.)
- All voltages for the SpiiPlus Motion Controller.

The PSM3U-48V-0.7kW is supplied from:

- Single AC external power supply within the voltage fluctuation range: 85-265Vac
- 24Vdc±10% for logic supply

PSM3U-48V-1.4k

The PSM3U-48V-1.4kW is a low-power regulated power supply, with dual DC bus voltage outputs (up to 1.4 kW), and supplies:

- Two 51Vdc nominal BUS voltage outputs, up to 700W (motor supply), for each output for the motor drivers such as DDM3U-4 or the like.
- All voltages for the SpiiPlus Motion Controller.

The PSM3U-48V-1.4kW is supplied from:

> Single AC external power supply within the voltage fluctuation range 85-265Vac
> 24Vdc ±10% for logic supply

The following table lists the PSM3U-48V-XXkW specifications.

Table 3-6. PSM3U-48V-XXkW Low-Power PS Specifications

Parameter	Description	Remarks
Power Input	AC Input voltage (drive supply): > Fluctuation Range: single phase 85-265Vac Input frequency: > Nominal frequency: 50Hz > Minimum frequency: 47Hz > Maximum frequency: 63Hz Inrush current: 50A peak Maximum input current: > 10.67A @85Vac (for 700W unit) > 21.3A @85Vac (for 1400W unit) Efficiency: 81%	
Power Output	Maximum output current: For 700W unit: > 14A (continuous and peak) @ Vin=265Vac > 10A continuous 14A peak @ Vin=85Vac Output voltage: > Nominal voltage: 51Vdc > Minimum voltage: 45Vdc > Maximum voltage: 57Vdc Output power: > Maximum output power: 700W (continuous and peak) for 700W unit @ Vin=265Vac and 500W continuous @ Vin=85Vac	

Parameter	Description	Remarks

Logic Supply	The Logic Supply is used to generate all necessary low voltages for the SPiiPlus Motion Controller.
	The Logic Supply is powered from an
	external 24Vdc control supply, and has the following characteristics:
	> Input voltage:
	    > Nominal voltage: 24Vdc
	    > Minimum voltage: 21.6Vdc
	    > Maximum voltage: 26.4Vdc
	> Input power: 55W, max.
	> Input current: 2.9A, max., @ 21.6V control supply input voltage
	> Supply inrush current
	    > Maximum inrush current value is less than 4Arms measured within first 400ms after logic supply input voltage is applied.
	    > After the first 400ms, the inrush current value continuously decreases and drops below 2.9A within 1sec.
	> Supply input voltage ripple:
	    > Maximum input voltage ripple amplitude: 5V peak-to-peak at 100Hz frequency
	    > In any condition: the input voltage level including the voltage ripple amplitude must not be lower than 21.6V and not greater than 26.4V	

Parameter	Description	Remarks
±12V supply for third party drive (DC/DC unit)	The PSM3U-48V-0.7kW Power Supply provides the option for supporting additional ±12V for third party drives.	Only for use with MB5U-CON-PS motherboard
Power Supply Fault output signal	This signal goes to “0” logic level and remains in this level if one of the power supply protection circuits is activated.	For over voltage fault recovery, the AC input must be removed and reapplied.

3.2.1.3 PSM3U-320V-4kW Power Supply

The following is a brief description of the PSM3U-320V-4kW power supply:

Power Supply	Number of Input Phases	Nominal Input Voltage Range [Vrms] -15% +10%	Max Cont. Input Current Per Phase [Arms]	Max Cont. Input Power [W]
PSM3U-320V-4KW	1	100 - 240 phase to neutral	13	3000
	3	100 - 240 phase to phase	11	4200

The following table lists the PSM3U-320V-4kW specifications.

Table 3-7. PSM3U-320V-4kW High-Power PS Specifications

Parameter	Description	Remarks
Power Input	Input voltage fluctuation range: > Single phase 85-265Vac input (phase-to-neutral) > Three phase 85-265Vac input (phase-to-phase) Input frequency: > Nominal frequency: 50Hz > Minimum frequency: 47Hz > Maximum frequency: 63Hz Inrush current: > Maximum inrush current value is 3.75 Arms measured for the first 20ms after power supply input voltage is applied. > After the first 20ms, the inrush current value continuously decreases and drops below 1.3 Arms within 5 sec. Efficiency: > 80% - for 85 - 265Vac single phase supply > 85% - for 195 - 265Vac three phase supply Input Power: see Maximum Input Power @ Single Phase Input 85 - 265Vac and Maximum Input Power @ Three Phase Input 195 - 265Vac. Input Current: see Maximum Input Current @ Single Phase Input 85 - 265Vac and Maximum Input Current @ Three Phase Input 195 - 265Vac.	The maximum input current for the AC input (drive supply) must not be more than 30A due to the AC input in connector J14 of the MC4U Interface (see J14 - Drive Supply Voltage Connector).

Parameter	Description	Remarks
Power Output	Maximum output current: > 8A continuous, 16A peak for 85 - 130Vac single phase input supply > 7.5A continuous, 15A peak for 195 - 265Vac single phase input supply > 12A continuous, 31A peak for 195 - 265Vac three phase input supply Output Voltage: see Output Voltage @ Single Phase Input 85 - 130Vac, Output Voltage @ Single Phase Input 195 - 265Vac and Output Voltage @ Three Phase Input 195 - 265Vac. Output Power: see Output Power @ Single Phase Input 85 - 130Vac , Output Power @ Single Phase Input 195 - 265Vac, and Output Power @ Three Phase Input 195 - 265Vac.	

Logic Supply	The Logic Supply is used to generate all necessary low voltages for the SPiiPlus Motion Controller.
	The Logic Supply is powered from an external 24Vdc control supply, and has the following characteristics:
	> Input voltage:
	  > Nominal voltage: 24Vdc
	  > Minimum voltage: 21.6Vdc
	  > Maximum voltage: 26.4Vdc
	> Input power: 55W, max.
	> Input current: 2.9A, max., @ 21.6V control supply input voltage
	> Supply inrush current
	  > Maximum inrush current value is less than 4Arms measured within first 400ms after logic supply input voltage is applied.
	  > After the first 400ms, the inrush current value continuously decreases and	

Parameter	Description	Remarks
	drops below 2.9A within 1sec. > Supply input voltage ripple: > Maximum input voltage ripple amplitude: 5V peak-to-peak at 100Hz frequency > In any condition: the input voltage level including the voltage ripple amplitude must not be lower than 21.6V and not greater than 26.4V.	
External Regeneration	Regeneration circuit activates when DC BUS output voltage exceeds 400V±3% (388 - 412V) External regeneration resistor >15Ω	The internal regeneration resistor must be disconnected from Power Supply J9 connector; otherwise it will work in parallel with the external resistor and heat the power supply heatsink for no reason.
Power Supply Fault output signal	This signal goes to “0” logic level and remains in this level if one of the power supply protection circuit is activated. A self-reset circuit generates a pulse every 130mSec to reset the signal to “1” logic level when the fault condition disappears.	This signal is sent to the SPiiPlus Motion Controller over the I^2C bus.
Discharge time	The 320v supplies have an active dumper that discharges the voltage to below 50v within less than 3 seconds.	

Maximum Input Power @ Single Phase Input 85 - 265Vac

Parameter	85Vac	100Vac	115Vac	130Vac	195Vac	230Vac	265Vac
Input power nominal (Pin), [W]	990	1152	1396	1640	2535	3023	3511
Input power peak (Pin peak), [W]	1580	1905	2393	2881	4670	5645	6621

Maximum Input Power @ Three Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Input power nominal **(Pin), [W]**	3720	4409	5097
Input power peak **(Pin peak), [W]**	8770	10492	12214

Maximum Input Current @ Single Phase Input 85 - 265Vac

Parameter	85Vac	100Vac	115Vac	130Vac	195Vac	230Vac	265Vac
Input current nominal **(Iin), [Arms]**	11.5	11.8	12.1	12.4	13	13.1	13.3
Input current peak **(Iin peak), [Arms]**	18.3	19.5	20.8	21.8	23.9	24.6	25

Maximum Input Current @ Three Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Input current nominal **(Iin), [Arms]**	11	11.1	11.1
Input current peak **(Iin peak), [Arms]**	25.9	26.3	26.7

Output Voltage @ Single Phase Input 85 - 130Vac

Parameter	85Vac	100Vac	115Vac	130Vac
Maximum output voltage **(Vout_max), [Vdc]**	119	135	160	184
Nominal output voltage @ nominal output current 16A **(Vout_nom), [Vdc]**	99	115	140	164
Minimum output voltage @ peak output current 32A **(Vout_peak), [Vdc]**	39	55	80	104

Output Voltage @ Single Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Maximum output voltage **(Vout_max), [Vdc]**	273	322	371
Nominal output voltage @ nominal output current 15.5A **(Vout_nom), [Vdc]**	253	302	351
Minimum output voltage @ peak output current 31A **(Vout_peak), [Vdc]**	193	242	291

Output Voltage @ Three Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Maximum output voltage (**Vout_max), [Vdc]**	273	322	371
Nominal output voltage @ nominal output current 23A **(Vout_nom), [Vdc]**	263	312	361
Minimum output voltage @ peak output current 62A **(Vout_peak), [Vdc]**	223	272	321

Output Power @ Single Phase Input 85 - 130Vac

Parameter	85Vac	100Vac	115Vac	130Vac
Nominal output power @ nominal output current 8A **(Pout_nom), [W]**	800	922	1117	1312
Peak output power @ peak output current 16A **(Pout_peak), [W]**	1264	1523	1914	2304

Output Power @ Single Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Nominal output power @ nominal output current 7.5A **(Pout_nom), [W]**	2027	2418	2808
Peak output power @ peak output current 15A **(Pout_peak), [W]**	3736	4516	5297

Output Power @ Three Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Nominal output power @ nominal output current 12A **(Pout_nom), [W]**	3162	3747	4333
Peak output power @ peak output current 31A **(Pout_peak), [W]**	7454	8918	10382

3.2.1.4 PSM3U-320V-8kW Power Supply

The following is a brief description of the PSM3U-320V-8kW power supply:

Power Supply	Number of Input Phases	Nominal Input Voltage Range [Vrms] -15% +10%	Max Cont. Input Current Per Phase [Arms]	Max Cont. Input Power [W]
PSM3U-320V-8kW	1	100 - 240 phase to neutral	25.8 with: > MB5U-CONT-PS2 > MB5U-ZZ > MB5U-ZV > MB5U-Z 24 with: > MB5U-CONT-PS > MB5U-YYYY > MB5U-ZZZ > MB5U-ZZW	6200 with: > MB5U-CONT-PS2 > MB5U-ZZ > MB5U-ZV > MB5U-Z 5760 with: > MB5U-CONT-PS > MB5U-YYYY > MB5U-ZZZ > MB5U-ZZW
	3	100 - 240 phase to phase	25.8 with: > MB5U-CONT-PS2 > MB5U-ZZ > MB5U-ZV > MB5U-Z 24 with: > MB5U-CONT-PS > MB5U-YYYY > MB5U-ZZZ > MB5U-ZZW	10730 with: > MB5U-CONT-PS2 > MB5U-ZZ > MB5U-ZV > MB5U-Z 9977 with: > MB5U-CONT-PS > MB5U-YYYY > MB5U-ZZZ > MB5U-ZZW

The PSM3U-320V-8kW is a high-power, non-regulated power supply and supplies:

> VACin x 1.4 nominal BUS voltage, up to 8.3kW (motor supply), providing power for the motor drivers such as DDM3U-2 and the like. (If 8.3kW is not enough power, use the PSM3U-320V-11kW power supply.)
> All voltages for SpiiPlus Motion Controller.

The PSM3U-320V-8kW is supplied from:

> Single or three-phase AC external power supply within the voltage fluctuation range 85-265Vac
> 24Vdc ±10% for logic supply

The following table lists the PSM3U-320V-8kW specifications.

Table 3-8. PSM3U-320V-8kW High-Power PS Specifications

Parameter	Description	Remarks
Power Input	Input voltage fluctuation range: > Single phase 85-265Vac input (phase-to-neutral) > Three phase 85-265Vac input (phase-to-phase) Input frequency: > Nominal frequency: 50Hz > Minimum frequency: 47Hz > Maximum frequency: 63Hz Inrush current: > Maximum inrush current value is 3.75 Arms measured for the first 20ms after power supply input voltage is applied. > After the first 20ms, the inrush current value continuously decreases and drops below 1.3 Arms within 5 sec. Efficiency: > 68% - for 85 - 265Vac single phase supply > 68% - for 195 - 265Vac three phase supply Input Power: see Maximum Input Power @ Single Phase Input 85 - 265Vac and Maximum Input Power @ Three Phase Input 195 - 265Vac. Input Current: see Maximum Input Current @ Single Phase Input 85 - 265Vac and Maximum Input Current @ Three Phase Input 195 - 265Vac.	The maximum input current for the AC input (drive supply) must not be more than 30A due to the AC input in connector J14 of the MC4U Interface (see J14 - Drive Supply Voltage Connector)

Parameter	Description	Remarks
Power Output	Maximum output current: > 16A continuous, 32A peak for 85 - 130Vac single phase input	

Parameter	Description	Remarks
	supply > 15.5A continuous, 31A peak for 195 - 265Vac single phase input supply > 23A continuous, 62A peak for 195 - 265Vac three phase input supply Output Voltage: see Output Voltage @ Single Phase Input 85 - 130Vac, Output Voltage @ Single Phase Input 195 - 265Vac and Output Voltage @ Three Phase Input 195 - 265Vac. Output Power: see Output Power @ Single Phase Input 85 - 130Vac, Output Power @ Single Phase Input 195 - 265Vac, and Output Power @ Three Phase Input 195 - 265Vac.	

<table>
<tr><th>Parameter</th><th>Description</th><th>Remarks</th></tr>
<tr><td>Logic Supply</td><td>The Logic Supply is used to generate all necessary low voltages for the SPiiPlus Motion Controller.

The Logic Supply is powered from an external 24Vdc control supply, and has the following characteristics:

> Input voltage:
  > Nominal voltage: 24Vdc
  > Minimum voltage: 21.6Vdc
  > Maximum voltage: 26.4Vdc
> Input power: 55W, max.
> Input current: 2.9A, max., @ 21.6V control supply input voltage
> Supply inrush current
  > Maximum inrush current value is less than 4Arms measured within first 400ms after logic supply input voltage is applied.
  > After the first 400ms, the inrush current value continuously decreases and drops below 2.9A within 1sec.
> Supply input voltage ripple:
  > Maximum input voltage ripple amplitude: 5V peak-to-peak at 100Hz frequency
  > In any condition: the input voltage level including the voltage ripple amplitude must not be lower than 21.6V and not greater than 26.4V.</td><td></td></tr>
</table>

Parameter	Description	Remarks
External Regeneration	Regeneration circuit activates when DC BUS output voltage exceeds 400V±3% (388 - 412V) External regeneration resistor >15Ω	The internal regeneration resistor must be disconnected from Power Supply J9 connector; otherwise it will work in parallel with the external resistor and heat the power supply heatsink for no reason.
Power Supply Fault output signal	This signal goes to “0” logic level and remains in this level if one of the power supply protection circuit is activated. A self-reset circuit generates a pulse every 130mSec to reset the signal to “1” logic level when the fault condition disappears.	This signal is sent to the SPiiPlus Motion Controller over the I^2C bus.
Discharge time	The 320v supplies have an active dumper that discharges the voltage to below 50v within less than 3 seconds.	

Table 3-9. Maximum Input Power @ Single Phase Input 85 - 265Vac

Parameter	85Vac	100Vac	115Vac	130Vac	195Vac	230Vac	265Vac
Input power nominal (Pin), [W]	1858.26	2240.83	2814.93	3388.94	5350.43	6462.57	7574.70
Input power peak (Pin peak), [W]	1732.26	2455.08	3539.31	4623.54	8437.97	10538.67	12639.37

Table 3-10. Maximum Input Power @ Three Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Input power nominal **(Pin), [W]**	8601.73	10251.99	11902.26
Input power peak **(Pin peak), [W]**	19100.49	23301.88	27503.27

Table 3-11. Maximum Input Current @ Single Phase Input 85 - 265Vac

Parameter	85Vac	100Vac	115Vac	130Vac	195Vac	230Vac	265Vac
Input current nominal **(Iin), [Arms]**	21.55	22.93	24.48	25.63	27.37	28.10	28.64
Input current peak **(Iin peak), [Arms]**	20.08	25.12	30.78	34.96	43.16	45.82	47.79

Table 3-12. Maximum Input Current @ Three Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Input current nominal **(Iin), [Arms]**	25.40	25.73	25.98
Input current peak (Iin peak), [Arms]	56.41	58.49	60.03

Table 3-13. Output Voltage @ Single Phase Input 85 - 130Vac

Parameter	85Vac	100Vac	115Vac	130Vac
Maximum output voltage (Vout_max), [Vdc]	118.98	135.24	159.63	184.03
Nominal output voltage @ nominal output current 16A **(Vout_nom), [Vdc]**	78.98	95.24	119.63	144.03
Minimum output voltage @ peak output current 32A **(Vout_peak), [Vdc]**	38.98	55.24	79.63	104.03

Table 3-14. Output Voltage @ Single Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Maximum output voltage (Vout_max), [Vdc]	273.48	322.27	371.06
Nominal output voltage @ nominal output current 15.5A **(Vout_nom), [Vdc]**	234.73	283.52	332.31
Minimum output voltage @ peak output current 31A **(Vout_peak), [Vdc]**	195.98	244.77	293.56

Table 3-15. Output Voltage @ Three Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Maximum output voltage (**Vout_max), [Vdc]**	273.48	322.27	371.06
Nominal output voltage @ nominal output current 23A **(Vout_nom), [Vdc]**	254.31	303.10	351.89
Minimum output voltage @ peak output current 62A **(Vout_peak), [Vdc]**	221.81	270.60	319.39

Table 3-16. Output Power @ Single Phase Input 85 - 130Vac

Parameter	85Vac	100Vac	115Vac	130Vac
Nominal output power @ nominal output current 16A **(Pout_nom), [W]**	1263.61	1523.83	1914.15	2304.48
Peak output power @ peak output current 32A **(Pout_peak), [W]**	1247.23	1767.66	2548.31	3328.95

Table 3-17. Output Power @ Single Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Nominal output power @ nominal output current 15.5A **(Pout_nom), [W]**	3638.30	4394.55	5150.80
Peak output power @ peak output current 31A **(Pout_peak), [W]**	6075.34	7587.84	9100.34

Table 3-18. Output Power @ Three Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Nominal output power @ nominal output current 23A **(Pout_nom), [W]**	5849.18	6971.36	8093.53
Peak output power @ peak output current 62A **(Pout_peak), [W]**	13752.35	16777.35	19802.35

3.2.1.5 PSM3U-320V-10kW Power Supply

The following is a brief description of the PSM3U-320V-10kW power supply:

Power Supply	Number of Input Phases	Nominal Input Voltage Range [Vrms] -15% +10%	Max Cont. Input Current Per Phase [Arms]	Max Cont. Input Power [W]
PSM3U-320V-10kW	1	100 - 240 phase to neutral	32 with: > MB5U-CONT-PS2 > MB5U-ZZ > MB5U-ZV > MB5U-Z 24 with: > MB5U-CONT-PS > MB5U-YYYY > MB5U-ZZZ > MB5U-ZZW	7680 with: > MB5U-CONT-PS2 > MB5U-ZZ > MB5U-ZV > MB5U-Z 5760 with: > MB5U-CONT-PS > MB5U-YYYY > MB5U-ZZZ > MB5U-ZZW
	3	100 - 240 phase to phase	32 with: > MB5U-CONT-PS2 > MB5U-ZZ > MB5U-ZV > MB5U-Z 24 with: > MB5U-CONT-PS > MB5U-YYYY > MB5U-ZZZ > MB5U-ZZW	13300 with: > MB5U-CONT-PS2 > MB5U-ZZ > MB5U-ZV > MB5U-Z 9980 with: > MB5U-CONT-PS > MB5U-YYYY > MB5U-ZZZ > MB5U-ZZW

The following table lists the PSM3U-320V-10kW specifications.

PSM3U-320V-10kW High-Power PS Specifications

Parameter	Description	Remarks
Power Input	Input voltage fluctuation range: > Single phase 85-265Vac input (phase-to-neutral) > Three phase 85-265Vac input (phase-to-phase) Input frequency: > Nominal frequency: 50Hz > Minimum frequency: 47Hz > Maximum frequency: 63Hz Inrush current: > Maximum inrush current value is 3.75 Arms measured for the first 20ms after power supply input voltage is applied. > After the first 20ms, the inrush current value continuously decreases and drops below 1.3 Arms within 5 sec. Efficiency: > 68% - for 85 - 265Vac single phase supply > 68% - for 195 - 265Vac three phase supply Input Power: see Maximum Input Power @ Single Phase Input 110 and 230Vac and Maximum Input Power @ Three Phase Input 195 - 265Vac. Input Current: see Maximum Input Current @ Single Phase Input 110 and 230Vac and Maximum Input Current @ Three Phase Input 195 - 265Vac.	The maximum input current for the AC input (drive supply) must not be more than 30A due to the AC input in connector J14 of the MC4U Interface (see J14 - Drive Supply Voltage Connector).

<table>
<tr><th>Parameter</th><th>Description</th><th>Remarks</th></tr>
<tr><td>Power Output</td><td>Maximum output current:
16A continuous, 32A peak for 85 - 130Vac single phase input supply
15A continuous, 31A peak for 195 - 265Vac single phase input supply
34A continuous, 70A peak for 195 - 265Vac three phase input supply
Output Voltage: see Output Voltage @ Single Phase Input 110Vac, Output Voltage @ Single Phase Input 230Vac and Output Voltage @ Three Phase Input 195 - 265Vac.

Output Power: see Output Power @ Single Phase Input 110Vac, Output Power @ Single Phase Input 230Vac, and Output Power @ Three Phase Input 195 - 265Vac.</td><td></td></tr>
<tr><td>Logic Supply</td><td>The Logic Supply is used to generate all necessary low voltages for the SPiiPlus Motion Controller.

The Logic Supply is powered from an external 24Vdc control supply, and has the following characteristics:
Input voltage:
Nominal voltage: 24Vdc
Minimum voltage: 21.6Vdc
Maximum voltage: 26.4Vdc
Input power: 55W, max.
Input current: 2.9A, max., @ 21.6V control supply input voltage
Supply inrush current
Maximum inrush current value is less than 4Arms measured within first 400ms after logic supply input voltage is applied.
After the first 400ms, the inrush current value continuously decreases and</td><td></td></tr>
</table>

Parameter	Description	Remarks
	drops below 2.9A within 1sec. > Supply input voltage ripple: > Maximum input voltage ripple amplitude: 5V peak-to-peak at 100Hz frequency > In any condition: the input voltage level including the voltage ripple amplitude must not be lower than 21.6V and not greater than 26.4V.	
External Regeneration	Regeneration circuit activates when DC BUS output voltage exceeds 400V±3% (388 - 412V) External regeneration resistor >15Ω	The internal regeneration resistor must be disconnected from Power Supply J9 connector; otherwise it will work in parallel with the external resistor and heat the power supply heatsink for no reason.
Power Supply Fault output signal	This signal goes to “0” logic level and remains in this level if one of the power supply protection circuit is activated. A self-reset circuit generates a pulse every 130mSec to reset the signal to “1” logic level when the fault condition disappears.	This signal is sent to the SPiiPlus Motion Controller over the I^2C bus.
Discharge time	The 320v supplies have an active dumper that discharges the voltage to below 50v within less than 3 seconds.	

Maximum Input Power @ Single Phase Input 110 and 230Vac

Parameter	110Vac	230Vac
Input power nominal (Pin), [W]	2800	5300
Input power peak (Pin peak), [W]	3500	8400

Maximum Input Power @ Three Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Input power nominal **(Pin), [W]**	12533	14973	17412
Input power peak **(Pin peak), [W]**	21940	26683	31427

Maximum Input Current @ Single Phase Input 110 and 230Vac

Parameter	110Vac	230Vac
Input current nominal **(Iin), [Arms]**	24.5	27
Input current peak **(Iin peak), [Arms]**	31	43

Maximum Input Current @ Three Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Input current nominal **(Iin), [Arms]**	37	38	38
Input current peak **(Iin peak), [Arms]**	65	67	69

Output Voltage @ Single Phase Input 110Vac

Parameter	110Vac
Nominal output voltage @ nominal output current 16A **(Vout_nom), [Vdc]**	119

Output Voltage @ Single Phase Input 230Vac

Parameter	230Vac
Nominal output voltage @ nominal output current 15.5A **(Vout_nom), [Vdc]**	283

Output Voltage @ Three Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Maximum output voltage (**Vout_max), [Vdc]**	274	323	372
Nominal output voltage @ nominal output current 23A **(Vout_nom), [Vdc]**	251	300	348
Minimum output voltage @ peak output current 62A **(Vout_peak), [Vdc]**	226	275	323

Output Power @ Single Phase Input 110Vac

Parameter	110Vac
Nominal output power @ nominal output current 32A **(Pout_nom), [W]**	1900
Peak output power @ peak output current 64A **(Pout_peak), [W]**	2500

Output Power @ Single Phase Input 230Vac

Parameter	230Vac
Nominal output power @ nominal output current 15A **(Pout_nom), [W]**	4400
Peak output power @ peak output current 31A **(Pout_peak), [W]**	7600

Output Power @ Three Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Nominal output power @ nominal output current 34A **(Pout_nom), [W]**	8523	10182	11840
Peak output power @ peak output current 70A **(Pout_peak), [W]**	15797	19212	22627

3.2.1.6 PSM3U-320V-11kW Power Supply

The following is a brief description of the PSM3U-320V-11kW power supply:

Power Supply	Number of Input Phases	Nominal Input Voltage Range [Vrms] -15% +10%	Max Cont. Input Current Per Phase [Arms]	Max Cont. Input Power [W]
PSM3U-320V-11kW	1	100 - 240 phase to neutral	30 (24 depending on motherboard setup)	6900 (5500 depending on motherboard setup)
	3	100 - 240 phase to phase	30 (24 depending on motherboard setup)	12000 (9600 depending on motherboard setup)

The PSM3U-320V-11kW is a high-power, non-regulated power supply, with dual DC bus voltage outputs (up to 11 kW) and supplies:

- Two outputs, VACin x 1.4 nominal BUS voltage up to 8.3kW for each output and up to 12kW for both outputs simultaneously, for the motor drivers such as DDM3U-2 or the like.
- All voltages for SpiiPlus Motion Controller.

The PSM3U-320V-11kW is supplied from:

- Single or three-phase AC external power supply within the voltage fluctuation range 85-265Vac
- 24Vdc ±10% for logic supply

The following table lists the PSM3U-320V-11kW specifications.

PSM3U-320V-11kW High-Power PS Specifications

Parameter	Description	Remarks
Power Input	Input voltage fluctuation range: > Single phase 85-265Vac input (phase-to-neutral) > Three phase 85-265Vac input (phase-to-phase) Input frequency: > Nominal frequency: 50Hz > Minimum frequency: 47Hz > Maximum frequency: 63Hz Inrush current: > Maximum inrush current value is 3.75 Arms measured for the first 20ms after power supply input voltage is applied. > After the first 20ms, the inrush current value continuously decreases and drops below 1.3 Arms within 5 sec. Efficiency: > 80% - for 85 - 265Vac single phase supply > 85% - for 195 - 265Vac three phase supply Input Power: see Maximum Input Power @ Single Phase Input 110Vac and Maximum Input Power @ Three Phase Input 230Vac. Input Current: see Maximum Input Current @ Single Phase Input 85 - 265Vac and Maximum Input Current @ Three Phase Input 195 - 265Vac.	The maximum input current for the AC input (drive supply) must not be more than 30A due to the AC input in connector J14 of the MC4U Interface (see J14 - Drive Supply Voltage Connector).

<table>
<tr><th>Parameter</th><th>Description</th><th>Remarks</th></tr>
<tr><td>Power Output</td><td>Maximum output current:
16A continuous, 64A peak for 85 - 130Vac single phase input supply
18A continuous, 62A peak for 195 - 265Vac single phase input supply
32A continuous, 124A peak for 195 - 265Vac three phase input supply
Output Voltage: see Output Voltage @ Single Phase Input 85 - 130Vac and Output Voltage @ Single Phase Input 195 - 265Vac.

Output Power: see Output Power @ Single Phase Input 85 - 130Vac and Output Power @ Three Phase Input 195 - 265Vac.</td><td></td></tr>
<tr><td>Logic Supply</td><td>The Logic Supply is used to generate all necessary low voltages for the SPiiPlus Motion Controller.

The Logic Supply is powered from an external 24Vdc control supply, and has the following characteristics:
Input voltage:
Nominal voltage: 24Vdc
Minimum voltage: 21.6Vdc
Maximum voltage: 26.4Vdc
Input power: 55W, max.
Input current: 2.9A, max., @ 21.6V control supply input voltage
Supply inrush current
Maximum inrush current value is less than 4Arms measured within first 400ms after logic supply input voltage is applied.
After the first 400ms, the inrush current value continuously decreases and drops below 2.9A within 1sec.</td><td></td></tr>
</table>

Parameter	Description	Remarks
	> Supply input voltage ripple: > Maximum input voltage ripple amplitude: 5V peak-to-peak at 100Hz frequency > In any condition: the input voltage level including the voltage ripple amplitude must not be lower than 21.6V and not greater than 26.4V.	
External Regeneration	Regeneration circuit activates when DC BUS output voltage exceeds 400V±3% (388 - 412V) External regeneration resistor >15Ω	The internal regeneration resistor must be disconnected from Power Supply J9 connector; otherwise it will work in parallel with the external resistor and heat the power supply heatsink for no reason.
Power Supply Fault output signal	This signal goes to “0” logic level and remains in this level if one of the power supply protection circuit is activated. A self-reset circuit generates a pulse every 130mSec to reset the signal to “1” logic level when the fault condition disappears.	This signal is sent to the SPiiPlus Motion Controller over the I^2C bus.
Discharge time	The 320v supplies have an active dumper that discharges the voltage to below 50v within less than 3 seconds.	

Maximum Input Power @ Single Phase Input 110Vac

Parameter	110Vac CE	110Vac UL
Input power nominal (Pin), [W]	3.3	2.6
Input power peak (Pin peak), [W]	9	9

Maximum Input Power @ Three Phase Input 230Vac

Parameter	230Vac CE	230Vac UL
Input power nominal **(Pin), [W]**	12.0	9.6
Input power peak **(Pin peak), [W]**	43	43

Maximum Input Current @ Single Phase Input 85 - 265Vac

Parameter	110Vac	230Vac
Input current nominal **(Iin), [Arms]**	30	30
Input current peak **(Iin peak), [Arms]**	81.5	

Maximum Input Current @ Three Phase Input 195 - 265Vac

Parameter	230Vac
Input current nominal **(Iin), [Arms]**	30
Input current peak (Iin peak), [Arms]	108.4

Output Voltage @ Single Phase Input 85 - 130Vac

Parameter	110Vac	230Vac
Nominal output voltage @ nominal output current 16A **(Vout_nom), [Vdc]**	133	3.2

Output Voltage @ Single Phase Input 195 - 265Vac

Parameter	230Vac
Nominal output voltage @ nominal output current 18A **(Vout_nom), [Vdc]**	313

Output Power @ Single Phase Input 85 - 130Vac

Parameter	110Vac	230Vac
Nominal output power @ nominal output current 16A **(Pout_nom), [W]**	2.6	5.5
Peak output power @ peak output current 64A **(Pout_ peak), [W]**	7.2	17.5

Output Power @ Three Phase Input 195 - 265Vac

Parameter	230Vac
Nominal output power @ nominal output current 32A **(Pout_nom), [W]**	10.2
Peak output power @ peak output current 124A **(Pout_ peak), [W]**	36.7

3.2.1.7 PSM3U-320/48V-0.7/8kW Power Supply

The following is a brief description of the PSM3U-320/48V-0.7/8kW power supply:

Power Supply	Number of Input Phases	Nominal Input Voltage Range [Vrms] -15% +10%	Max Cont. Input Current Per Phase [Arms]	Max Cont. Input Power [W]
PSM3U-320/48V-8/0.7kW	1	100 - 240 phase to neutral	28.5 (24 with the applicable motherboard)	6700 (5500 with the applicable motherboard)
	3	100 - 240 phase to phase	24.4 (24 with the applicable motherboard)	9400 (9200 with the applicable motherboard)

> PSM3U-320/48V-0.7/8kW

The PSM3U-320/48V-0.7/8kW is required if DDM3U-2 and DDM3U-4 motor drivers are installed together in the 19” MC4U.

The PSM3U-320/48V-0.7/8kW is a dual output, mixed voltages power supply, high (up to 8 kW) and low-power (up to 0.7 kW) and supplies:

- VACin x 1.4 nominal BUS voltage, up to 8 kW (motor supply), for the DDM3U-2 or the like
- 320Vdc nominal BUS voltage, up to 8kW (motor supply), for the DDM3U-2
- 48Vdc nominal BUS voltage, up to 700W (motor supply), for the DDM3U-4 drive or the like
- All voltages for SpiiPlus Motion Controller

The PSM3U-320/48V-0.7/8kW is supplied from:

- Single or three-phase AC external power supply within the voltage fluctuation range 85-265Vac.
- 24Vdc ±10% for logic supply.

When using both low and high-power supplies in the same unit, the low voltage is connected to J30 (V2) on the motherboard, and the high voltage is connected to J29 (V1) on the motherboard.

The PSM3U-320/48V-0.7/8kW power supply has two output drive bus voltages:

- 110Vac phase
- 230Vac 1 phase / 3 phase

The following lists the specifications.

Parameter	Description	
Certification Type	CE	UL
Input Voltage [Vac] range	> Single phase: 85-265 > Three phase: 230±10%	
Input Voltage [Vdc]	120-375	
Input frequency, nominal [Hz]	50-60	
Drive bus voltage(s) at nominal load [Vdc]	> 110Vac 1 phase - 51/133 > 230vAc 1 phase - 51/302 > 230Vac 3 phase - 51/313	
Output power, cont. (nominal load) [kW]	CE	UL
110Vac 1 phase	2.6	2.6
230vAc 1 phase	5.4	5.4
230Vac 3 phase	7.9	7.9
Output power, peak for 1 second (peak load) [kW]	> 110Vac 1 phase - 4.3 > 230vAc 1 phase - 9.5 > 230Vac 3 phase - 19.1	
Output current, cont [A]	> 110Vac 1 phase - 10/16 > 230vAc 1 phase - 14/15.5 > 230Vac 3 phase - 14/23	
Output current, peak for 1 second [A]	> 110Vac 1 phase - 14/32 > 230vAc 1 phase - 14/31 > 230Vac 3 phase - 14/62	
Input current at nominal load [Arms]	CE	UL
110Vac 1 phase	29.9	24.0
230vAc 1 phase	28.5	24.0
230Vac 3 phase	24.4	24.0

Parameter	Description	
Input current at peak load [Arms]	> 110Vac 1 phase - 48.7 > 230vAc 1 phase - 50.8 > 230Vac 3 phase - 57.3	
Input power at nominal load [kW]	CE	UL
110Vac 1 phase	3.3	2.6
230vAc 1 phase	6.7	5.5
230Vac 3 phase	9.4	9.2
Input power at peak load [kW] - @110Vac 1 phase / 230Vac 1 phase	> 110Vac 1 phase - 5.4 > 230vAc 1 phase - 11.8 > 230Vac 3 phase - 22	
Efficiency - @110Vac 1 phase / 230Vac 1 phase	> 80% for 0.7kW > 85% for 8Kw	
Power Supply Dissipation at nomial load [W]	> 1 phase - 255W > 3 phase - 295W	
Dimensions; Height, Width, Length [mm]	129 x 178 x 242	
Weight [gram]	2,900	
Internal regeneration resisitor	100W	
Power supply protection types	> Power supply missing > Temperature too high > Over current protection only for 0.7kW > Over voltage protection only for 0.7kW > Power supply not ready only for 8kW > Regeneration fault only for 8kw > Phase lost only for 3 phase input and 8kW	

3.2.1.8 PSM3U-320V-20KW Power Supply

A set of two PSM3U-320V-10KW power supplies are used to construct the PSM3U-320V-20KW power supply. Therefore, the specifications that follow apply to the PSM3U-320V-10KW.

Power Supply	Number of Input Phases	Nominal Input Voltage Range [Vrms] -15% +10%	Max Cont. Input Current Per Phase [Arms]	Max Cont. Input Power [W]
PSM3U-320V-20kW	1	85-265 phase to neutral	54	10600
	3	85-265 phase to phase	76	30000

The PSM3U-320V-20kW is an unregulated power supply (it is a combination of two PSM3U-320V-10KW power supplies). This supply is used to generate the two separate DC BUS voltages (motor supply) for the motor drivers (PWM or linear).

The PSM3U-320V-20kW is supplied from a one- or three-phase AC external power supply within the voltage range of 100-230Vac nominal and generates two separate DC BUS output voltages of 140Vdc to 320Vdc nominal.

Table 3-19. PSM3U-320V-10KW PS Specifications

Parameter	Description	Remarks
Power Input	Input voltage range: > Single phase 85-265Vac input (phase-to-neutral) > Three phase 85-265Vac input (phase-to-phase) Input frequency: > Nominal frequency: 50Hz > Minimum frequency: 47Hz > Maximum frequency: 63Hz Inrush current: > Maximum inrush current value is 3.75 Arms measured for the first 20 ms after power supply input voltage is applied. > After the first 20 ms, the inrush current value continuously decreases and drops below 1.3 Arms within 5 sec. Maximum input power: see Maximum Input Power @ Three Phase Input 195 - 265Vac Maximum input current: see Maximum Input Current @ Three Phase Input 195 - 265Vac Efficiency: 68% - for 195 - 265Vac three phase supply.	
Power Output	Maximum output current: 34A continuous, 70A peak for 195 - 265Vac three phase input supply. Output voltage: see Output Voltage @ Three Phase Input 195 - 265Vac Output power: see Output Power @ Three Phase Input 195 - 265Vac	

Logic Supply	The Logic Supply is used to generate all necessary low voltages for the SPiiPlus Motion Controller.
	The Logic Supply is powered from an external 24Vdc control supply, and has the following characteristics:
	> Input voltage:
	  > Nominal voltage: 24Vdc
	  > Minimum voltage: 21.6Vdc
	  > Maximum voltage: 26.4Vdc
	> Input power: 55W, max.
	> Input current: 2.9A, max., @ 21.6V control supply input voltage	

Parameter	Description	Remarks

	> Supply inrush current
	  > Maximum inrush current value is less than 4Arms measured within first 400ms after logic supply input voltage is applied.
	  > After the first 400ms, the inrush current value continuously decreases and drops below 2.9A within 1sec.
	> Supply input voltage ripple:
	  > Maximum input voltage ripple amplitude: 5V peak-to-peak at 100Hz frequency
	  > In any condition: the input voltage level including the voltage ripple amplitude must not be lower than 21.6V and not greater than 26.4V.	

Power Supply Fault output signal	Signal designator: PS_FLT Goes to “0” logic level and remains in this stage in case of one of the power supply protection circuit is activated. The self-reset circuit will generate pulse every 130 ms to reset this stage when the fault condition has disappeared. In this case the power supply fault signal goes to “1” logic level Propagation delay - time from the moment when one of the power supply fault conditions has occurred to switching power supply fault signal to “0” logic level: > For the Phase Lost protection: 80-120 ms > For the Power Supply Missing protection: 550-650 ms > For the Regeneration Fault protection: less than 10 µS > For the Power Supply Temperature Too High protection: 5-15 ms	
Discharge time	The 320v supplies have an active dumper that discharges the voltage to below 50v within less than 3 seconds.	

Table 3-20. Maximum Input Power @ Three Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Input power nominal **(Pin), [W]**	12533.38	14972.90	17412.42
Input power peak	21939.91	26683.42	31426.93

Parameter	195Vac	230Vac	265Vac
(Pin peak), [W]			

Table 3-21. Maximum Input Current @ Three Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Input current nominal **(Iin), [Arms]**	37.01	37.59	38.01
Input current peak (Iin peak), [Arms]	64.79	66.98	68.60

Table 3-22. Output Voltage @ Three Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Maximum output voltage **(Vout_max), [Vdc]**	274	323	372
>(Vout_nom), [Vdc]	251	300	348
Minimum output voltage @ peak output current 70A (Vout_peak), [Vdc]	226	275	323

Table 3-23. Output Power @ Three Phase Input 195 - 265Vac

Parameter	195Vac	230Vac	265Vac
Nominal output power @ nominal output current 34A **(Pout_nom), [W]**	8523	10182	11840
Peak output power @ peak output current 70A **(Pout_peak), [W]**	15797	19212	22627

Table 3-24. SPiiPlus 3U DC-DC Logic Supply Output Voltages

Name	Voltage	Accuracy	Max Current	Reference	Ripple & Noise
+5L	5V	±2%	3A	DGND	<100mVp-p
-5L	-5V	±2%	300mA	DGND	<100mVp-p
12VA	+12V	±5%	600mA	AGND	<70mVp-p
-12VA	-12V	±5%	600mA	AGND	<70mVp-p

Name	Voltage	Accuracy	Max Current	Reference	Ripple & Noise
+5F	5V	±2%	1A	AGND	<100mVp-p
+5U	5V	±2%	1A	DGND	<100mVp-p

3.2.1.9 PSM3U-560V-7kW Power Supply

The following lists the PSM3U-560V-7kW specifications.

Paremeter	Description
Input Voltage [Vac] range - 3 phase	400±10%
Input Voltage [Vdc]	565
Input frequency, nominal [Hz]	50-60
Drive bus voltage(s) at nominal load [Vdc] - @400Vac 3 phase	543
Output power, cont. (nominal load) [kW] - @400Vac 3 phase	6.5
Output power, peak for 1 second. (peak load) [kW] - @400Vac 3phase	27.8
Output current, cont [A] - 3 phase	12
Output current, peak for 1 second [A] - @400Vac 3 phase	60
Input current at nominal load [Arms] - @400Vac 3 phase input	11
Input current at peak load [Arms] - @400Vac 3 phase input	47
Input power at nominal load [kW] - @400Vac 3 phase	7.7
Input power at peak load [kW] - @400Vac 3 phase	32.6
Efficiency - @3 phase	85%
Power Supply Dissipation at nominal load [W] - @3 phase	95W
Dimensions; Height, Width, Length [mm]	129 x 178 x 242
Weight [gram]	1,600
Internal Regeneration Resistor	100W
Power supply protection types	> Power supply missing

Paremeter	Description
	> Temperature too high > Power supply not ready > Regeneration fault > Phase lost (for 3 phase only)

3.2.1.10 PSM3U-100V-3kW Power Supply

The following table lists the PSM3U-100V-3kW specifications.

PSM3U-100V-3kW High-Power PS Specifications

Parameter	Description	Remarks
Power Input	Input voltage fluctuation range: > Single phase 60-80Vac input (phase-to-neutral) > Three phase 60-80Vac input (phase-to-phase) Input frequency: > Minimum frequency: 50Hz > Maximum frequency: 60Hz Efficiency: > 68% - for 70Vac single phase supply > 68% - for 70Vac three phase supply Input Voltage (Vdc): > Minimum Voltage: 85 Vdc > Maximum Voltage: 113 Vdc Input Power: see Maximum Input Power @ Single Phase Input 70Vac and Maximum Input Power @ Three Phase Input 70Vac. Input Current: see Maximum Input Current @ Single Phase Input 70Vac and Maximum Input Current @ Three Phase Input 70Vac.	The maximum input current for the AC input (drive supply) must not be more than 30A due to the AC input in connector J14 of the MC4U Interface (see J14 - Drive Supply Voltage Connector).

Parameter	Description	Remarks
Power Output	Maximum output current: > 15.5A continuous, 31A peak for 70Vac single phase input supply > 23A continuous, 46A peak for 70Vac three phase input supply Output Voltage: see Output Voltage @ Single Phase Input 70Vac and Output Voltage @ Three Phase Input 70Vac. Output Power: see Output Power @ Single Phase Input 70Vac and Output Power @ Three Phase Input 70Vac.	

Logic Supply	The Logic Supply is used to generate all necessary low voltages for the SPiiPlus Motion Controller.
	The Logic Supply is powered from an external 24Vdc control supply, and has the following characteristics:
	> Input voltage:
	  > Nominal voltage: 24Vdc
	  > Minimum voltage: 21.6Vdc
	  > Maximum voltage: 26.4Vdc
	> Input power: 55W, max.
	> Input current: 2.9A, max., @ 21.6V control supply input voltage
	> Supply inrush current
	  > Maximum inrush current value is less than 4Arms measured within first 400ms after logic supply input voltage is applied.
	  > After the first 400ms, the inrush current value continuously decreases and drops below 2.9A within 1sec.
	> Supply input voltage ripple:
	  > Maximum input voltage ripple amplitude: 5V peak-to-peak at 100Hz frequency
	  > In any condition: the input voltage level including the	

Parameter	Description	Remarks
	voltage ripple amplitude must not be lower than 21.6V and not greater than 26.4V.	
External Regeneration	Regeneration circuit activates when DC BUS voltage exceeds 123V. External regeneration resistor >15Ω	The internal regeneration resistor must be disconnected from Power Supply J9 connector; otherwise it will work in parallel with the external resistor and heat the power supply heatsink for no reason.
Power Supply Fault output signal	This signal goes to "0" logic level and remains in this level if one of the power supply protection circuit is activated. A self-reset circuit generates a pulse every 130mSec to reset the signal to "1" logic level when the fault condition disappears.	This signal is sent to the SPiiPlus Motion Controller over the I^2C bus.
Discharge time	The 320v supplies have an active dumper that discharges the voltage to below 50v within less than 3 seconds.	

Maximum Input Power @ Single Phase Input 70Vac

Parameter	60Vac	70Vac	80Vac
Input power nominal (Pin), [W]	1662	2000	2339
Input power peak (Pin peak), [W]	2784	3423	4063

Maximum Input Power @ Three Phase Input 70Vac

Parameter	60Vac	70Vac	80Vac
Input power nominal **(Pin), [W]**	2607	3109	3611
Input power peak **(Pin peak), [W]**	4663	5612	6561

Maximum Input Current @ Single Phase Input 70Vac

Parameter	60Vac	70Vac	80Vac
Input current nominal **(Iin), [Arms]**	27.9	28.6	29.1
Input current peak **(Iin peak), [Arms]**	46.8	48.9	50.5

Maximum Input Current @ Three Phase Input 70Vac

Parameter	60Vac	70Vac	80Vac
Input current nominal **(Iin), [Arms]**	25.3	25.6	25.9
Input current peak (Iin peak), [Arms]	45.3	46.3	47.1

Output Voltage @ Single Phase Input 70Vac

Parameter	60Vac	70Vac	80Vac
Nominal output voltage @ nominal output current 15.5A **(Vout_nom), [Vdc]**	73	88	103

Output Voltage @ Three Phase Input 70Vac

Parameter	60Vac	70Vac	80Vac
Nominal output voltage @ nominal output current 23A **(Vout_nom), [Vdc]**	77	92	107

Output Power @ Single Phase Input 70Vac

Parameter	60Vac	70Vac	80Vac
Nominal output power @ nominal output current 15.5A **(Pout_nom), [W]**	1130	1360	1590
Peak output power @ peak output current 31A **(Pout_peak), [W]**	2004	2465	2925

Output Power @ Three Phase Input 70Vac

Parameter	60Vac	70Vac	80Vac
Nominal output power @ nominal output current 23A **(Pout_nom), [W]**	1773	2110	2456
Peak output power @ peak output current 46A **(Pout_peak), [W]**	3358	4040	4724

3.3 Motor Drives

The motor drives supply the driving power for the motors connected to the MC4U. The following types of motor drives are available:

- PWM Drives
- Nano PWM Drives

- LDM3U Single Axis Linear Drive

3.3.1 PWM Drives

The MC4U line of universal digital PWM drive modules are specifically designed to provide high performance and cost effective solution for demanding multi-axis applications. The drives are optimized for low noise, providing the best possible jitter and velocity smoothness and are fully programmable for easy setup and diagnostics. The low-power modules include up to four drives and high-power modules include two drives for optimal costs and performance.

The PWM drive modules support linear and rotary motors covering a wide power range of 100W to 19kW. Each drive can be programmed to control any type of single, two or three phase motor.

The PWM drives are supplied in the following versions:

- DDM3U-X-60V-4A (for low-power motors; suitable only for MC4U-19-Piano-enc.)
  - DDM3U-2-60V-4A - 2 drives module, 24-60V, 4/5A
  - DDM3U-4-60V-4A - 4 drives module, 24-60V, 4/5A
- DDM3U-1-320V-XX
  - DDM3U-1-320V-30A-SR - 1 drive 24 – 320V, 30/60A
  - DDM3U-1-320V-45A-SR - 1 drive 24 – 320V, 45/90A
- DDM3U-X-320V-YY (for high-power motors)
  - DDM3U-1-320V-5A - 1 drive module, 24 – 320V, 5/10A
  - DDM3U-1-320V-10A - 1 drive module, 24 – 320V, 10/20A
  - DDM3U-1-320V-15A - 1 drive module, 24 – 320V, 15/30A
  - DDM3U-1-320V-20A - 1 drive module, 24 – 320V, 20/40A
  - DDM3U-2-320V-1A - 2 drives module, 24 – 320V, 1/2A, 250W
  - DDM3U-2-320V-1A - 2 drives module, 24 – 320V, 1/2A, 250W
  - DDM3U-2-320V-2A - 2 drives module, 24 – 320V, 2/4A, 500W
  - DDM3U-2-320V-3A - 2 drives module, 24 – 320V, 3/6A, 750W
  - DDM3U-2-320V-5A - 2 drives module, 24 – 320V, 5/10A
  - DDM3U-2-320V-10A - 2 drives module, 24 – 320V, 10/20A
  - DDM3U-2-320V-15A - 2 drives module, 24 – 320V, 15/30A
  - DDM3U-2-320V-20A - 2 drives module, 24 – 320V, 20/40A
  - DDM3U-2-560V-5A - 2 drives module, 560V, 5/10A
  - DDM3U-2-560V-10A - 2 drives module, 560V, 10/20A
  - DDM3U-2-560V-15A - 2 drives module, 560V, 15/30A
  - DDM3U-4-320V-1A - 4 drives module, 24 – 320V, 1/2A, 250W
  - DDM3U-4-320V-2A - 4 drives module, 24 – 320V, 2/4A, 500W
  - DDM3U-4-320V-3A - 4 drives module, 24 – 320V, 3/6A, 750W
- LDM3U-XX-YY-D

- LDM3U-28V-8A-D - Linear Drive, 28Vdc, 4A/8A digitally controlled
- LDM3U-28V-16A-D - Linear Drive, 28Vdc, 4A/16A digitally controlled
- LDM3U-55V-8A-D - Linear Drive, 55Vdc, 4A/8A digitally controlled
- LDM3U-55V-16A-D - Linear Drive, 55Vdc, 4A/16A digitally controlled

3.3.1.1 DDM3U-X-60V-4A Low-Power Motor Drive

The DDM3U-X-60V-4A has 2 or 4 Pulse Width Modulation (PWM) Power Bridges (amplifiers) for 2 or 4 Servo (DC Brushless, DC Brush) and/or 2 or 4 Step motors. There are two different assembly options available for DDM3U-X-60V-4A power block, as detailed in the following table:

Table 3-25. DDM3U-X-60V-4A Power Block Assembly Options

Power Block Name	Number of PWM Bridges	Number of Axes	PWM Bridge Continuous/ 3 Sec Peak Output Current [A]	Input Power Supply Nominal Voltage Range [Vdc]
DDM3U-2-60V-2A	2	2 DC Brushless	4/5	18 - 60
		2 DC Brush	2.8/5	
		2 Step	2.8/3.5	
DDM3U-4-60V-2A	4	4 DC Brushless	4/5	18 - 60
		4 DC Brush	2.8/5	
		4 Step	2.8/3.5	

3.3.1.1.1 DDM3U-X-60V-4A Specifications

All power for the DDM3U-X-60V-4A is supplied through the PSM3U-48V-0.7kW Power Supply.

Table 3-26. DDM3U-X-60V-4A Specifications

	Description	Remarks
Motor types supported	Brush, Brushless or Step	
Number of axes supported	Four for Brush/Brushless or two for Step motors	
Input Power	Nominal Input Supply Voltage: 18 - 60Vdc Input Current & Power - see DDM3U-X-60V-4A Maximum Input Current and Input Power. Inrush current: > Maximum inrush current value is less than 1 Arms measured within first 10 ms after drive supply input voltage is applied > After the first 10ms, the inrush current value will gradually decrease to below 0.2 Arms within 1 sec	The drive supply voltage may reach 66V during motor regeneration. If the voltage ripple during regeneration exceeds the specified value (72V), then the over voltage protection is activated.

	Description	Remarks
Input Control Supply	Control supply input voltage: > Nominal voltage: 24Vdc > Minimum voltage: 19Vdc > Maximum voltage: 29Vdc Control supply input power: 15.8W max. Control supply input current: 0.83A max. @ 19V control supply input voltage Control supply inrush current: > Maximum inrush current value is less than 32 Arms measured within first 500 µSec after drive supply input voltage is applied. > After the first 500 µSec, the inrush current gradually decreases to below 0.83 A within 1 sec. Control supply input voltage ripple: > Maximum input voltage ripple amplitude: 5V peak-to-peak at 100Hz frequency. > Under any condition, the instantaneous input voltage level (including voltage ripple amplitude) must be between 19V and 29V.	
Total Output Power	See DDM3U-X-60V-4A Total Output Current and Output Power.	
Output Power to Motor	See DDM3U-X-60V-4A Power Motor Output Parameters	

Table 3-27. DDM3U-X-60V-4A Maximum Input Current and Input Power

	Number of Axes	Maximum Continuous Input Current [Arms]	Maximum Peak Input Current (3 Sec) [Arms]	Maximum Continuous Input Power [W]	Maximum Peak Input Power (3 Sec) [W]
DDM3U-2-60V-4A	2 DC Brushless	5.5	6.8	362	452
DDM3U-4-60V-4A	4 DC Brushless	10.9	13.7	723	904
DDM3U-2-60V-4A	2 DC Brush	5.2	9.2	341	608
	2 Step	3.4	4.2	222	276
DDM3U-4-60V-4A	4 DC Brush	10.3	18.4	682	1216
	4 Step	6.7	8.4	444	552

Table 3-28. DDM3U-X-60V-4A Total Output Current and Output Power

	Number of Axes	Maximum Continuous Total Output Current [Arms/Sin Peak]	Maximum Peak Total Output Current (3 Sec) [Arms/Sin Peak]	Maximum Continuous Total Output Power [W]	Maximum Peak Total Output Power (3 Sec) [W]
DDM3U-2-60V-4A	2 DC Brushless	5.6/8	7.1/10	352	440
DDM3U-4-06V-4A	4 DC Brushless	11.2/16	14.1/20	704	880
DDM3U-2-60V-4A	2 DC Brush	5.6/NA	10/NA	336	600
	2 Step	4/5.6	7.1/10	212	264
DDM3U-4-60V-4A	4 DC Brush	11.2/NA	20/NA	672	1200
	4 Step	8/11.2	14.2/20	424	528

Table 3-29. DDM3U-X-60V-4A Power Motor Output Parameters

Type of Connected Motor	Maximum Continuous Phase Output Current [Arms/Sine Peak]	Maximum Peak Phase Output Current (3 Sec) [Arms/Sin Peak]	Maximum Phase-to-Phase Output Voltage [V]	Maximum Continuous Output Power [W]	Maximum Peak Output Power (3 Sec) [W]
DC Brushless	2.8/4	3.5/5	36	176	220
DC Brush	2.8/NA	5/NA	52	168	300
Step	2/2.8	2.8/3.5	52 (see note)	106	132

The maximum output voltage for a Step motor Phase S to Phase T is 52V; but for Phase S or Phase T to Phase R it is 36V.

The power output parameters are based on 40°C ambient temperature.

3.3.1.2 DDM3U-1-320V-XX-SR Motor Drive

The DDM3U-1-320V-XX-SR is a rack mounted dual axis motor drive, driving one PWM (pulse width modulation) axis or one digital axis. There are two different configurations available for the DDM3U-1-320V-XX-SR dual axis digital driver:

- DDM3U-1-320V-30A-SR
- DDM3U-1-320V-45A-SR

The SPiiPlusNT/DC motion controller, via the Controller- Drive interface, controls the drive output current.

The following motor types can be connected to drive:

- DC Brushless
- AC Induction
- DC Brush

3.3.1.2.1 DDM3U-1-320V-XX-SR Specifications

Table 3-30. DDM3U-1-320V-XX-SR Specifications

	Description	Remarks
Supported motor types	Brush, Brushless or Induction.	
Number of axes supported	One	
Axis designations	19" MC4U and 22" MC4U: X	
Input Voltage	Drive supply input voltage range: > Nominal: 24Vdc - 320Vdc > Minimal: 21Vdc (24Vdc -10%) > Maximum: 370Vdc (320Vdc +15%)	
Input Power	Drive supply nominal input power for 230 Vac 3-phase supply: > 7021 W continuous and 13423 W peak for DDM3U-1-320V-30A-SR > 10243 W continuous and 19097 W peak for DDM3U-1-320V-45A-SR Drive supply input power for 265 Vac 3-phase supply: > 8089 W continuous and 15578 W peak for DDM3U-1-320V-30A-SR > 11859 W continuous and 22329 W peak for DDM3U-1-320V-45A-SR	During motor regeneration a rapid increase in the input voltage up to 420V is allowed. If the voltage ripple during regeneration exceeds this 420V, then the over voltage protection is activated. There is no regeneration circuit implemented in the DDM3U-1-320V-XX-SR drive. It is part of the power supply module.
Inrush Current	Bus voltage is supplied via PSM3U-320V-10kW power supply after the DDM3U-1-320V-XX-YY driver has been installed in the MC4U:	

	Description	Remarks
	> Maximum inrush current value is less then 1 Arms measured within first 10 ms after drive supply input voltage is applied. > After the first 10 ms, the inrush current value continuously decreases and drops below 0.2 Arms within 1 sec.	
Input Current	Drive supply input current for 230 Vac 3-phase supply: > 22.85 A continuous and 46.18 A peak for DDM3U-1-320V-30A-SR > 34.28 A continuous and 69.58 A peak for DDM3U-1-320V-45A-SR Drive supply input current for 265 Vac 3-phase supply: > 22.74 A continuous and 45.89 A peak for DDM3U-1-320V-30A-SR > 34.12 A continuous and 69.07 A peak for DDM3U-1-320V-45A-SR	
Input Control Supply	Control supply input voltage: > Nominal voltage: 24 Vdc > Minimum voltage: 19 Vdc > Maximum voltage: 29 Vdc Control supply input power: 15 W max. Control supply input current: 0.8 A max. @ 19 V control supply input voltage	

3.3.1.2.2 DDM3U-1-320V-XX-SR PWM Power Bridge Specification

There is one PWM Power Bridge on the DDM3U-1-320V-XX-SR-NP board. The PWM power bridge is digitally controlled with 20kHz sampling rate and 20kHz PWM.

Table 3-31. PWM Power Bridge Specifications

Item	Description	Remarks
Power Bridge architecture	> Three phase PWM bridge > Six power transistors	
Supported motor types	> DC Brush Step Motor > DC Brushless > AC Induction	
PWM Power Bridge Output	Drive supply nominal output power for 230 Vac 3-phase supply: Output voltage phase-to-phase: > 185 Vrms continuous and 175 Vrms peak for DDM3U-1-320V-30A-SR > 180 Vrms continuous and 165 Vrms peak for DDM3U-1-320V-45A-SR Output current sine amplitude: > 30 A continuous and 60 A peak for DDM3U-1-320V-30A-SR > 45 A continuous and 90 A peak for DDM3U-1-320V-45A-SR	
PWM Power Bridge Output (Continued)	Output power > 6784 W continuous and 12853 W peak for DDM3U-1-320V-30A-SR > 9913 W continuous and 18202 W peak for DDM3U-1-320V-45A-SR Drive supply nominal output power for 265 Vac 3-phase supply: Output voltage phase-to-phase: > 214 Vrms continuous and 204 Vrms peak for DDM3U-1-320V-30A-SR > 209 Vrms continuous and 195 Vrms peak for DDM3U-1-320V-45A-SR Output current sine amplitude: > 30 A continuous and 60 A peak for DDM3U-1-320V-30A-SR > 45 A continuous and 90 A peak for DDM3U-1-320V-45A-SR Output power > 7863 W continuous and 15017 W peak for DDM3U-1-320V-30A-SR	

Item	Description	Remarks
	> 11533 W continuous and 21458 W peak for DDM3U-1-320V-45A-SR	

3.3.1.2.3 DDM3U-1-320V-XX-SR Drive Protection Circuits

The following protection devices and circuits are incorporated in the DDM3U-1-320V-XX-SR board:

- Fuses
  - Control supply input fuse
    - Type: subminiature, very fast action
    - Ampere rating: 2A
    - Voltage rating: 125Vdc
    - Agency approvals: UL
- Drive Supply Too High (Over Voltage Protection)
  - Disable by internal HW protection circuit two drivers when DC BUS voltage is more than 445±5% (422 - 467V)
  - The message: "Drive Alarm: Power supply too high" is generated by controller for display.
  - Propagation delay time - from the time when the drive supply voltage crosses the over voltage level to the time of disabling the PWM signals: less than 5mS.
- Drive Supply Missing
  - Disable by internal HW protection circuit two drivers when the drive power supply is missing or drive supply input fuse has blown.
  - The protection is activated when the drive power supply voltage is less than 19.5V±5% (18.5 - 20.5V)
  - The message: "Drive Alarm: Power supply is missing" is generated by controller for display.
  - Propagation delay - from the time when the drive supply voltage crosses the under voltage level to the time of disabling the PWM signals: less than 5mS.
- Drive 24Vdc Control Supply Missing
  - Disable by internal HW protection circuit two drivers when the drive 24Vdc control supply is missing or 24Vdc control supply input fuse has blown.
  - The protection is activated when the drive 24Vdc control supply voltage is less than 8V±10%
  - The message: "Drive Alarm: 5019" is generated by controller for display.
  - Propagation delay time - from the time when the drive supply voltage crosses the under voltage level to the time of disabling the PWM signals: 150-250µS.
- Drive Phase-to-Phase Short Circuit

  - When the current through one of the three outputs of PWM Power Bridge exceeds the short circuit maximum level as defined below, the corresponded drive is disabled.
  - Maximum short circuit current level:
    - 135A ±5% (128 - 142A) for DDM3U-1-320V-30A-SR driver
    - 200A ±5% (190 - 210A) for DDM3U-1-320V-45A-SR driver
  - The message: “Drive Alarm: Short circuit” is generated by controller for display.
  - Propagation delay time - from the moment when the current via one of the motor phases crosses the short circuit current limit level to the time of disabling the PWM signals: less than 2µS.
- Drive Short to Ground
  - When the current from one of the three outputs of PWM Power Bridge to the ground exceeds the short to ground maximum level as defined below, the corresponded drive is disabled.
  - Short to ground maximum level:
    - 135A ±5% (128 - 142A) for DDM3U-1-320V-30A-SR driver
    - 200A ±5% (190 - 210A) for DDM3U-1-320V-45A-SR driver
  - The message: “Drive Alarm: Short circuit” is generated by controller for display.
  - Propagation delay time - from the moment when the current to ground via one of the PWM Power Bridge outputs crosses the short to ground current limit level to the time of disabling the PWM signals: less than 2µS
- Drive Over Current
  - When the current through one of the three outputs of PWM Power Bridge exceeds the over current maximum level as defined below, the corresponded drive is disabled.
  - Maximum over current level:
    - 90A ±5% (85 - 95A) for DDM3U-1-320V-30A-SR driver
    - 120A ±5% (114 - 126A) for DDM3U-1-320V45A-SR driver
  - The message: “Drive Alarm: Over current” is generated by controller for display.
  - Propagation delay time - from the moment when the current via one of the motor phases crosses the over current limit level to the time of disabling the PWM signals: less than 5mS.
- Drive Over Temperature Protection
  - Disable by internal HW protection circuit the corresponded drive when the temperature on heat sink in PWM Power Bridge area will be more then 100±5ºC.
  - The message: “Drive Alarm: Temperature too high” is generated by controller for display.
  - Propagation delay time -from the moment when the temperature on the heat sink cross the temperature limit level to the time of disabling the PWM signals: 1-5mS.

3.3.1.3 DDM3U-2-320V-XA High-Power Motor Drive

The DDM3U-2-320V-XA (where “X” relates to the Amperage) is a dual axis Pulse Width Modulation (PWM) digital universal driver for the following types of motors:

- DC Brushless
- AC Induction
- DC Brush Step Motor

The number of motors connected to the driver can be one or two. The SPiiPlus Motion Controller, via the Controller - Driver interface, controls the output current for each of two PWM digital drivers.

There are four different options available for DDM3U-2-320V-XA dual axis digital driver:

- DDM3U-2-320V-5A
- DDM3U-2-320V-10A
- DDM3U-2-320V-15A
- DDM3U-2-320V-20A

3.3.1.3.1 DDM3U-2-320V-XA Specifications

All power for the DDM3U-2-320V-XA is supplied through the PSM3U Power Supply.

Table 3-32. DDM3U-2-320V-XA Power Supply Input Specifications

	Description	Remarks
Supported motor types	Brush, Brushless or Step.	
Number of axes supported	Two	

<table>
<tr><th></th><th>Description</th><th>Remarks</th></tr>
<tr><td>Axis designations</td><td>MC4U-9-Piano-enc:
X(0), A(2)
MC4U-11-Piano-enc and MC4U-19-Piano-enc:
X(0), Y(1)
(also A(2) and B(3) if two Motor Drives are installed)
MC4U-13-Piano-AX7:
X(0), Y(1)
(also Z(4) and T(5) if two Motor Drives are installed)</td><td></td></tr>
<tr><td>Input Power</td><td>Drive supply input voltage range:
> Nominal: 24 Vdc - 320Vdc
> Minimal: 21 Vdc (24 Vdc -10%)
> Maximum: 370 Vdc (320 Vdc +15%)
Inrush current:
> Maximum inrush current value is less than 1 Arms measured within first 10 ms after drive supply input voltage is applied.
> After the first 10 ms, the inrush current value will continuously decrease and drop below 0.2 Arms within 1 sec.</td><td>During motor regeneration a rapid increase in the input voltage up to 420 V is allowed. If the voltage ripple during regeneration exceeds this 420 V, then the over voltage protection is activated.

It should be noted that the maximum input power cannot be more than 11,102 W due to the maximum input current that is limited by the maximum available PCB fuse size: 30A/600Vdc</td></tr>
</table>

	Description	Remarks
	For maximum input power with a 115Vac, single phase supply see Maximum Input Power [W] @ Continuous/Peak Current for 115Vac ±15%, Single Phase Main Supply. For maximum input power with a 230Vac, single phase supply see Maximum Input Power [W] @ Continuous/Peak Current for 230Vac ±15%, Single Phase Main Supply. For maximum input power with a 230Vac, three phase supply see Maximum Input Power [W] @ Continuous/Peak Current for 230Vac ±15%, Three Phase Main Supply.	
Input Current	For maximum input current with a 115Vac, single phase supply see Maximum Input Current (Continuous/Peak) [A] for 115Vac ±15%, Single Phase Main Supply. For maximum input current with a 230Vac, single phase supply see Maximum Input Current (Continuous/Peak) [A] for 230Vac ±15%, Single Phase Main Supply. For maximum input current with a 230Vac, three phase supply see Maximum Input Current (Continuous/Peak) [A] for 230Vac ±15%, Three Phase Main Supply.	
Input Control Supply	Control supply input voltage: > Nominal voltage: 24	

	Description	Remarks
	Vdc > Minimum voltage: 19 Vdc > Maximum voltage: 29 Vdc Control supply input power: 15 W max. Control supply input current: 0.8 A max. @ 19 V control supply input voltage Control supply inrush current: > Maximum inrush current value is less than 2 Arms measured within first 200 ms after drive supply input voltage is applied. > After the first 200 ms, the inrush current value will continuously decrease and drop below 1.25 A within 1 sec. Control supply input voltage ripple: > Maximum input voltage ripple amplitude: 5 V peak-to-peak at 100 Hz frequency. > In any condition: the input voltage level including the voltage ripple amplitude must not be lower than 19 V and not greater than 29 V	

Table 3-33. Maximum Input Power [W] @ Continuous/Peak Current for 115Vac ±15%, Single Phase Main Supply

DDM3U-2-320V-XA	# of Axes	85Vac	100Vac	115Vac	130Vac
DDM3U-2-320V-5A (5/10A)	1	427 777	487 898	578 1078	668 1258
	2	782 1268	902 1509	1084 1870	1265 2231
DDM3U-2-320V-10A (10/20A	1	775 1260	895 1500	1076 1860	1256 2231
	2	1264 1374	1505 1854	1866 2574	2227 3294
DDM3U-2-320V-15A (15/30A	1	1060 1468	1241 1828	1512 2369	1783 2909
	2	1476 117	1837 938	2379 2161	2921 3241
DDM3U-2-320V-20A (20/40A)	1	1268 1382	1508 1862	1869 2582	2230 3302
	1.5 cont./ 2 peak	1472 140	1833 140	2374 278	2915 1926

Table 3-34. Maximum Input Power [W] @ Continuous/Peak Current for 230Vac ±15%, Single Phase Main Supply

DDM3U-2-320V-XA	# of Axes	195Vac	230Vac	265Vac
DDM3U-2-320V-5A (5/10A)	1	1001 1920	1182 2281	1363 2642
	2	1930 3554	2292 4276	2655 4998
DDM3U-2-320V-10A (10/20A	1	1918 3540	2279 4260	2640 4980
	2	3550 5935	4272 7375	4994 8815

DDM3U-2-320V-XA	# of Axes	195Vac	230Vac	265Vac
DDM3U-2-320V-15A (15/30A	1	2777 4890	3319 5971	3861 7052
	2	4909 7204	5993 9366	7077 11527
DDM3U-2-320V-20A (20/40A)	1	3553 5942	4274 7381	4996 8821
	1.5 cont./ 2 peak	4900 7303	5982 10182	7064 13062

Table 3-35. Maximum Input Power [W] @ Continuous/Peak Current for 230Vac ±15%, Three Phase Main Supply

DDM3U-2-320V-XA	# of Axes	195Vac	230Vac	265Vac
DDM3U-2-320V-5A (5/10A)	1	1025 2016	1206 2376	1387 2737
	2	2026 3936	2388 4657	2751 5379
DDM3U-2-320V-10A (10/20A	1	2014 3922	2374 4642	2735 5362
	2	3932 7462	4654 8902	5376 10342
DDM3U-2-320V-15A (15/30A	1	2991 5749	3533 6830	4075 7911
	2	5768 10640	6852 12801	7936 14963
DDM3U-2-320V-20A (20/40A)	1	3934 7469	4656 8908	5378 10348
	1.5 cont./ 2 peak	5759 13411	6841 16290	7923 19170

Table 3-36. Maximum Input Current (Continuous/Peak) [A] for 115Vac ±15%, Single Phase Main Supply

DDM3U-2-320V-XA	# of Axes	85Vac	100Vac	115Vac	130Vac
DDM3U-2-320V-5A (5/10A)	1	3.9 7.8	3.9 7.8	3.9 7.7	3.8 7.7
	2	7.9 15.8	7.8 15.7	7.7 15.5	7.7 15.4
DDM3U-2-320V-10A (10/20A	1	7.8 15.7	7.7 15.6	7.7 15.4	7.6 15.3
	2	15.8 33.4	15.6 32.3	15.5 31.5	15.3 31.0
DDM3U-2-320V-15A (15/30A	1	11.8 24.2	11.7 23.8	11.6 23.4	11.5 23.1
	2	24.3 50.8	23.9 50.5	23.5 50.3	23.2 48.1
DDM3U-2-320V-20A (20/40A)	1	15.8 33.6	15.7 32.4	15.5 31.5	15.4 31.1
	1.5 cont./ 2 peak	24.3 70.1	23.8 70.0	23.4 68.3	23.2 67.7

Table 3-37. Maximum Input Current (Continuous/Peak) [A] for 230Vac ±15%, Single Phase Main Supply

DDM3U-2-320V-XA	# of Axes	195Vac	230Vac	265Vac
DDM3U-2-320V-5A (5/10A)	1	3.8 7.6	3.8 7.5	3.8 7.5
	2	7.6 15.2	7.6 15.1	7.6 15.1
DDM3U-2-320V-10A (10/20A	1	7.6 15.1	7.5 15.0	7.5 15.0
	2	15.1 30.3	15.1 30.2	15.0 30.1

DDM3U-2-320V-XA	# of Axes	195Vac	230Vac	265Vac
DDM3U-2-320V-15A (15/30A	1	11.4 22.7	11.3 22.6	11.3 22.6
	2	22.8 45.9	22.7 45.6	22.6 45.3
DDM3U-2-320V-20A (20/40A)	1	15.1 30.4	15.1 30.2	15.1 30.1
	1.5 cont./ 2 peak	22.8 61.9	22.7 61.1	22.6 60.6

Table 3-38. Maximum Input Current (Continuous/Peak) [A] for 230Vac ±15%, Three Phase Main Supply

DDM3U-2-320V-XA	# of Axes	195Vac	230Vac	265Vac
DDM3U-2-320V-5A (5/10A)	1	3.8 7.6	3.8 7.5	3.8 7.5
	2	7.6 15.1	7.6 15.1	7.6 15.0
DDM3U-2-320V-10A (10/20A	1	7.5 15.1	7.5 15.0	7.5 15.0
	2	15.1 30.1	15.1 30.0	15.0 30.0
DDM3U-2-320V-15A (15/30A	1	11.3 22.6	11.3 22.6	11.3 22.5
	2	22.7 45.4	22.6 45.2	22.6 45.1
DDM3U-2-320V-20A (20/40A)	1	15.1 30.2	15.1 30.1	15.0 30.0
	1.5 cont./ 2 peak	22.7 60.5	22.6 60.2	22.5 60.1

3.3.1.3.2 DDM3U-2-320V-XA PWM Power Bridge Specification

There are two identical PWM Power Bridges on the DDM3U-2-320V-XA board. Four types with different current levels (Cont/Peak) are available:

- 5/10A – DDM3U-2-320V-5A

- 10/20A – DDM3U-2-320V-10A
- 15/30A – DDM3U-2-320V-15A
- 20/40A – DDM3U-2-320V-20A

Table 3-39. PWM Power Bridge Specifications

	Description	Remarks
Power Bridge architecture	Three phase PWM bridge	
Supported Motor types	Brush, Brushless or Step.	
Output Current	See Maximum Phase Output Current (Continuous/Peak) [A].	
Output Voltage	For minimum output voltage for 115Vac, single phase see Minimum Output Voltage (Phase-to-Phase) [Vrms] @ Continuous/Peak Current for 115Vac ±15%, Single Phase Main Supply. For minimum output voltage for 230Vac, single phase see Minimum Output Voltage (Phase-to-Phase) [Vrms] @ Continuous/Peak Current for 230Vac ±15%, Single Phase Main Supply. For minimum output voltage for 230Vac three phase see Minimum Output Voltage (Phase-to-Phase) [Vrms] @ Continuous/Peak Current for 230Vac ±15%, Three Phase Main Supply.	
Output Power	For maximum output power for 115Vac, single phase see Maximum Output Power [W] @ Continuous/Peak Current for 115Vac ±15%, Single Phase Main Supply. For maximum output power for 230Vac, single phase see Maximum Output Power [W] @ Continuous/Peak Current for 230Vac ±15%, Single Phase Main Supply. For maximum output power for 230Vac three phase see Maximum Output Power [W] @ Continuous/Peak Current for 230Vac ±15%, Three Phase Main Supply.	

Table 3-40. Maximum Phase Output Current (Continuous/Peak) [A]

DDM3U-2-320V-XA	# of Axes	Sine Amplitude	rms Value
DDM3U-2-320V-5A (5/10A)	1	5 10	3.5 7.1
	2	10 20	7.1 14.1
DDM3U-2-320V-10A (10/20A	1	10 20	7.1 14.1
	2	20 40	14.1 28.3
DDM3U-2-320V-15A (15/30A	1	15 30	10.6 21.2
	2	30 60	21.2 42.4
DDM3U-2-320V-20A (20/40A)	1	20 40	14.1 28.3
	1.5 cont./ 2 peak	30 80	21.2 56.6

Table 3-41. Minimum Output Voltage (Phase-to-Phase) [Vrms] @ Continuous/Peak Current for 115Vac ±15%, Single Phase Main Supply

DDM3U-2-320V-XA	# of Axes	85Vac	100Vac	115Vac	130Vac
DDM3U-2-320V-5A (5/10A)	1	66 60	75 70	90 84	105 99
	2	60 48	70 58	84 73	99 87
DDM3U-2-320V-10A (10/20A	1	60 48	70 58	84 73	99 87
	2	48 25	58 35	73 49	87 64

DDM3U-2-320V-XA	# of Axes	85Vac	100Vac	115Vac	130Vac
DDM3U-2-320V-15A (15/30A	1	54 36	64 46	78 61	93 76
	2	36 0	46 11	61 26	76 40
DDM3U-2-320V-20A (20/40A)	1	48 25	58 35	73 49	87 64
	1.5 cont./ 2 peak	36 0	46 0	61 1	76 17

Table 3-42. Minimum Output Voltage (Phase-to-Phase) [Vrms] @ Continuous/Peak Current for 230Vac ±15%, Single Phase Main Supply

DDM3U-2-320V-XA	# of Axes	195Vac	230Vac	265Vac
DDM3U-2-320V-5A (5/10A)	1	159 153	188 182	217 211
	2	153 141	182 170	211 200
DDM3U-2-320V-10A (10/20A	1	153 141	182 170	211 200
	2	141 118	170 147	200 176
DDM3U-2-320V-15A (15/30A	1	147 129	176 159	205 188
	2	129 94	159 124	188 153
DDM3U-2-320V-20A (20/40A)	1	141 118	170 147	200 176
	1.5 cont./ 2 peak	129 71	159 100	188 130

Table 3-43. Minimum Output Voltage (Phase-to-Phase) [Vrms] @ Continuous/Peak Current for 230Vac ±15%, Three Phase Main Supply

DDM3U-2-320V-XA	# of Axes	195Vac	230Vac	265Vac
DDM3U-2-320V-5A (5/10A)	1	162 160	192 190	221 219
	2	160 157	190 186	219 215
DDM3U-2-320V-10A (10/20A	1	160 157	190 186	219 215
	2	157 149	186 178	215 207
DDM3U-2-320V-15A (15/30A	1	159 153	188 182	217 211
	2	153 141	182 170	211 200
DDM3U-2-320V-20A (20/40A)	1	1857 149	186 178	215 207
	1.5 cont./ 2 peak	153 133	182 163	211 192

Table 3-44. Maximum Output Power [W] @ Continuous/Peak Current for 115Vac ±15%, Single Phase Main Supply

DDM3U-2-320V-XA	# of Axes	85Vac	100Vac	115Vac	130Vac
DDM3U-2-320V-5A (5/10A)	1	402 733	462 852	552 1032	642 1212
	2	733 1179	852 1418	1032 1778	1212 2137
DDM3U-2-320V-10A (10/20A	1	733 1179	852 1418	1032 1778	1212 2137
	2	1179 1213	1418 1692	1778 2410	2137 3128

DDM3U-2-320V-XA	# of Axes	85Vac	100Vac	115Vac	130Vac
DDM3U-2-320V-15A (15/30A	1	992 1339	1171 1698	1441 2237	1710 2776
	2	1339 0	1698 820	2237 1898	2776 2975
DDM3U-2-320V-20A (20/40A)	1	1179 1213	1418 1692	1778 2410	2137 3128
	1.5 cont./ 2 peak	1339 0	1698 0	2237 98	2776 1676

Table 3-45. Maximum Output Power [W] @ Continuous/Peak Current for 230Vac ±15%, Single Phase Main Supply

DDM3U-2-320V-XA	# of Axes	195Vac	230Vac	265Vac
DDM3U-2-320V-5A (5/10A)	1	971 1870	1150 2229	1330 2588
	2	1870 3454	2229 4172	2588 4890
DDM3U-2-320V-10A (10/20A	1	1870 3454	2229 4172	2588 4890
	2	3454 5762	4172 7199	4890 8636
DDM3U-2-320V-15A (15/30A	1	2698 4751	3236 5829	3775 6906
	2	4751 6926	5829 9081	6906 11236
DDM3U-2-320V-20A (20/40A)	1	3454 5762	4172 7199	4890 8636
	1.5 cont./ 2 peak	4751 6944	5829 9817	6906 12691

Table 3-46. Maximum Output Power [W] @ Continuous/Peak Current for 230Vac ±15%, Three Phase Main Supply

DDM3U-2-320V-XA	# of Axes	195Vac	230Vac	265Vac
DDM3U-2-320V-5A (5/10A)	1	995 1965	1174 2325	1354 2684
	2	1965 3835	2325 4554	2684 5272
DDM3U-2-320V-10A (10/20A	1	1965 3835	2325 4554	2684 5272
	2	3835 7289	4554 8726	5272 10162
DDM3U-2-320V-15A (15/30A	1	2912 5610	3451 6687	3990 7765
	2	5610 10361	6687 12516	7765 14671
DDM3U-2-320V-20A (20/40A)	1	3835 7289	4554 8726	5272 10162
	1.5 cont./ 2 peak	5610 13051	6687 15925	7765 18798

3.3.1.4 DDM3U-4-320V-XA Motor Drive

The DDM3U-4-320V-XA (where “XA” relates to Amperage) is a rack mounted two and four axes PWM (pulse width modulation) digital driver. It can support any two- and three-phase motor.

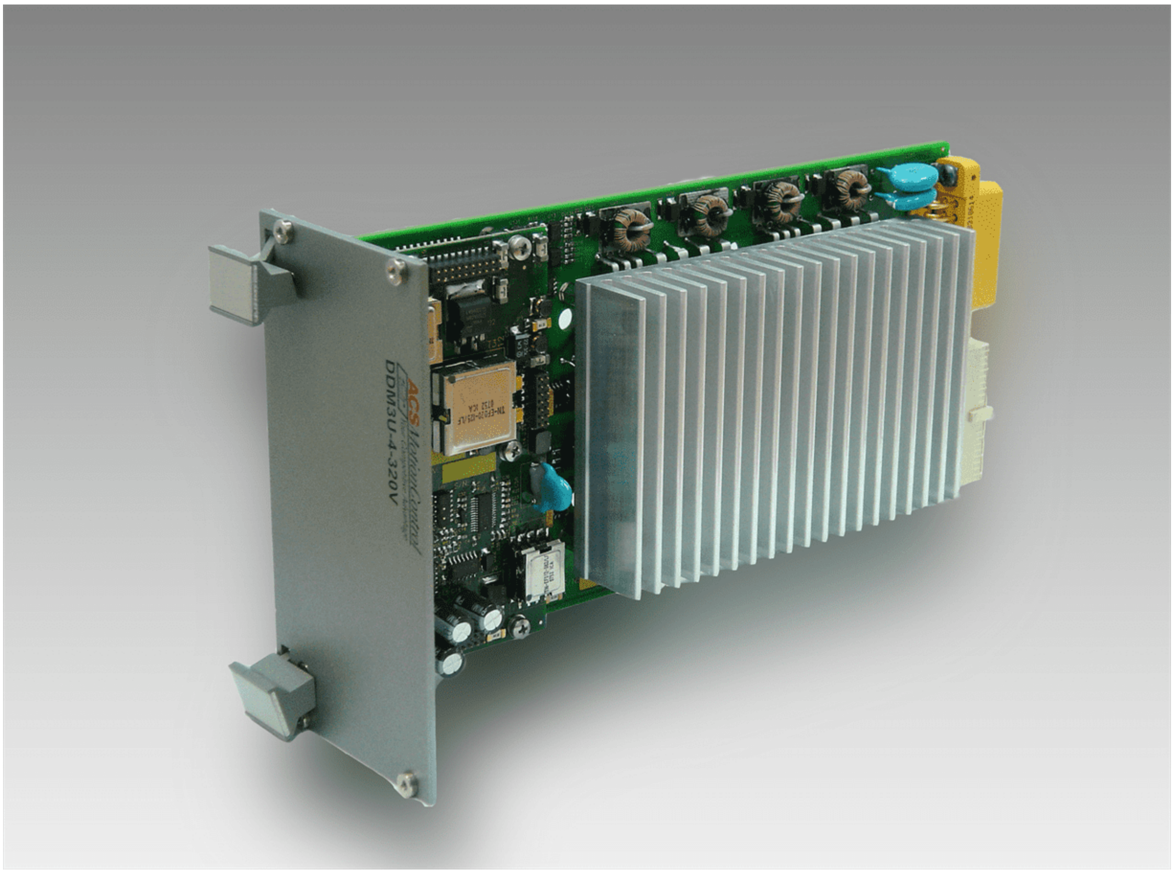


Figure 3-4. DDM3U-4-320V-XA Motor Drive

There are three different models available for DDM3U-4-320V-XA motor driver:

> DDM3U-4-320V-1A

> DDM3U-4-320V-2A

> DDM3U-4-320V-3A

The DDM3U-4-320V-XA motor drive can be connected to the Controller, Power Supply and motors via the MB5U-V (installed in the MC4U-9-Piano-enc), or via the MB5U-4-320V or the MB5U-ZZV (installed in the MC4U-19-Piano-enc) motherboards.

It is designed to operate from nominal voltages up to 320 Vdc and three current levels are available: 1A continuous/2A peak, 2A continuous/4A peak, and 3A continuous/6A peak.

3.3.1.4.1 DDM3U-4-320V-XA Power Supply Input Specification

In order to comply with the EN61326 safety standard, a line filter and varistors must be employed.
Varistors that are used must have a diameter of 20 mm, with a working voltage of 275 Vac, and a clamping voltage of 710 V @ 100 A.
The varistors must be installed between protective earth and line filter inputs, as well as between line filter inputs.
Recommended varistor manufacturers are: Wurth electronic, Littlefuse, Nippon Chemicon.

All power for the DDM3U-4-320V-XA is supplied through the PSM3U-320V-XkW Power Supply.

Table 3-47. DDM3U-4-320V-XA Power Supply Input Specifications

Item	Description	Remarks
Input power	Drive supply input voltage range: > Nominal: 24 Vdc - 320 Vdc > Minimal: 21Vdc (24 Vdc -10%) > Maximum: 370 Vdc (320 Vdc +15%)	
Drive supply input voltage ripple during regeneration	The input voltage can be increased up to 420 Vdc during the motor regeneration. If, however, the voltage ripple during regeneration exceeds 420 Vdc, then the over voltage protection is activated.	The drive gets the “drive power supply” dc voltage from the PSM3U-320V-XkW only, there is no other option to supply this voltage externally to the MC4U. For more details about power supplies refer to PSM3U Power Supplies. There is no regeneration circuit implemented in DDM3U-4-320V-XA. It is part of the power supply.

Item	Description	Remarks
Inrush current	> Maximum inrush current value is less than 1 Arms measured within the first 10 ms after drive supply input voltage is applied. > After the first 10 ms, the inrush current value decreases linearly and drops below 0.2 Arms within 1sec.	Bus voltage is supplied via thePSM3U-320V-XkW power supply after the DDM3U-4-320V-xx driver has been installed into the MC4U.
Maximum input power	For DDM3U-4-320V-1A: 1150 W/2300 W continuous/peak For DDM3U-4-320V-2A: 2200 W/4400 W continuous/peak For DDM3U-4-320V-3A: 3400 W/6800 W continuous/peak	Values given for four three-phase motors operated simultaneously @ 265 Vac.
Maximum input current	For DDM3U-4-320V-1A: 3.3 A/6.5 A continuous/peak For DDM3U-4-320V-2A: 6.2 A/12.5 A continuous/peak For DDM3U-4-320V-3A: 10 A/20 A continuous/peak	Values given for four three-phase motors operated simultaneously @ 265 Vac.

3.3.1.4.2 DDM3U-4-320V-XA Control Supply Input Specification

Table 3-48. DDM3U-4-320V-XA Control Supply Input Specifications

	Description
Control supply input voltage	> Nominal voltage: 24 Vdc ±10% > Minimum voltage: 21.6 Vdc > Maximum voltage: 26.6 Vdc
Control supply input power	Maximum input power: 20 W
Control supply input current	Maximum input current: 0.9 A @ 21.6 V control supply input voltage
Control supply inrush current	> Maximum inrush current value is less than 2 Arms measured within first 200 ms after drive supply input voltage is applied. > After the first 200 ms, the inrush current value decreases linearly and drops below 0.8 A within 1 sec.
Control supply input protection	The DDM3U-4-320V-XA has built-in protection against: > Inadvertent connection of the control supply to reverse polarity > Missing 24 Vdc control supply

3.3.1.4.3 DDM3U-4-320V-XA PWM Power Bridge Specification

	Description
DDM3U-320V-1A Power Bridge	
Maximum output voltage (phase-to-phase) @ continuous/peak current	220 Vrms ± 5% @ 265 Vac single or three phase
Maximum phase output current	For one power bridge: 1 A (sine amplitude) continuous and 2 A (sine amplitude) peak for 1 second. This corresponds to 0.7 A/1.4 Arms.
Maximum output power (± 5%)	> For one power bridge: 260 W continuous and 520 W peak > Total for drive power bridges: 1040 W continuous and 2080 W peak
DDM3U-320V-2A Power Bridge	

	Description
Maximum output voltage (phase-to-phase) @ continuous/peak current	220Vrms ± 5% @ 265Vac single or three phase
Maximum phase output current	For one power bridge: 2 A (sine amplitude) continuous and 4 A (sine amplitude) peak for 1 second. This corresponds to 1.4 A/2.8 Arms.
Maximum output power (± 5%)	> For one power bridge: 510 W continuous and 1020 W peak > Total for drive power bridges: 2120 W continuous and 4240 W peak
DDM3U-320V-3A Power Bridge	
Maximum output voltage (phase-to-phase) @ continuous/peak current	220 Vrms ± 5% @ 265 Vac single or three phase
Maximum phase output current	For one power bridge: 3 A (sine amplitude) continuous and 6 A (sine amplitude) peak for 1 second. This corresponds to 2.1 A/4.2 Arms.
Maximum output power (± 5%)	> For one power bridge: 750 W continuous and 1500 W peak > Total for drive power bridges: 3000 W continuous and 6000 W peak

3.3.1.4.4 DDM3U-4-320V-XA Drive Protection Circuits

The DD3U-4-320V-XA incorporate the following protection circuits:

- Drive Supply Too High (Over Voltage Protection)
    - Disable by internal HW protection circuit all drivers when DC BUS voltage is more than 445 ±5% (422 - 467V)
    - The message: “Drive Alarm: Power supply too high” is generated by the controller.
    - Propagation delay - the time from which the drive supply voltage crosses the over voltage level to the issuing the disable the PWM signals: less than 5 ms.
- Drive Supply Missing
    - Disable by internal HW protection circuit all drivers when the drive power supply is missing or drive supply input fuse is blown.
    - The protection is activated when the drive power supply voltage is less than 19.5 V±5% (18.5 - 20.5V)
    - The message: “Drive Alarm: Power down” is generated by the controller.

    - Propagation delay - the time from which the drive supply voltage crosses the under voltage level to the issuing of the disable the PWM signals: less than 5 ms.
- Drive 24 Vdc Control Supply Missing
    - Disable by internal HW protection circuit all drivers when the drive 24Vdc control supply is missing or 24Vdc control supply input fuse is blown.
    - The protection is activated when the drive 24 Vdc control supply voltage is less than 8 V ±10%
    - The message: "Drive Alarm: 5019" is generated by the controller.
    - Propagation delay - the time from which the drive 24 Vdc control supply voltage crosses the under voltage level to the issuing of the disable the PWM signals: 2 ms
- Drive Phase-to-Phase Short Circuit
    - When the current through one of the three outputs of PWM Power Bridge exceeds the short circuit maximum level: 22 A ±5%, the corresponding drive is disabled.
    - The message: "Drive Alarm: Short circuit" is generated by the controller.
    - Propagation delay - time from which the current via one of the motor phases crosses the short circuit current limit level to the issuing of the disable the PWM signals: less than 2µS.
- Drive Short to Ground
    - When the current from one of the three outputs of PWM Power Bridge to the ground exceeds the short to ground maximum level: 22 A ±5%, the corresponding drive is disabled.
    - The message: "Drive Alarm: Short circuit" is generated by the controller.
    - Propagation delay - time from which the current to ground via one of the PWM Power Bridge outputs crosses the short to ground current limit level to the issuing of the disable the PWM signals: less then 2µS
- Drive Over Current
    - When the current through one of the three outputs of PWM Power Bridge exceeds the over current maximum level as defined below, the corresponded drive is disabled.
    - Maximum over current level: 13A ±5%
    - The message: "Drive Alarm: Over current" is generated by the controller.
    - Propagation delay - time from the moment when the current via one of the motor phases cross the over current limit level to disable the PWM signals: less then 5mS
- Drive Over Temperature Protection
    - Disable by internal HW protection circuit the corresponded drive when the temperature on heat sink in PWM Power Bridge area is more than 100 ±5 ^{0}C.
    - The message: "Drive Alarm: Temperature too high" is generated by the controller.
    - Propagation delay - time from which the temperature on the heat sink crosses the temperature limit level to the issuing of the disable the PWM signals: 1-5 ms.

3.3.2 Nano PWM Drives

The Nano PWM drives for the MC4U are supplied in the following versions:

- DDM3U-1-100V-15A-NP Motor Drive
- DDM3U-1-320V-15A-NP Motor Drive

3.3.2.1 DDM3U-1-100V-15A-NP Motor Drive

The DDM3U-1-100V-15A-NP is a rack mounted single-axis PWM digital universal drive.

The SPiiPlusNT/DC-NP motion controller, via the Controller- Drive interface, controls the drive output current.

The following motor types can be connected to drive:

- DC Brushless
- AC Induction
- DC Brush

3.3.2.1.1 DDM3U-1-100V-15A-NP Specifications

DDM3U-1-100V-15A-NP Specifications

	Description	Remarks
Supported motor types	Brush, Brushless or Induction.	
Number of axes supported	One	
Axis designations	19" MC4U and 22" MC4U: X	
Input Voltage	Drive supply input voltage range: > Nominal: 24Vdc - 100Vdc > Minimal: 21Vdc (24Vdc - 10%) > Maximum: 105Vdc (100Vdc +5%)	

	Description	Remarks
Input Power	Drive supply input power @100Vdc: 1139W continuous and 2190W peak.	During motor regeneration a rapid increase in the input voltage up to 130V is allowed. If the voltage ripple during regeneration exceeds this 130V, then the over voltage protection is activated. There is no regeneration circuit implemented in the DDM3U-1-100V-15A-NP drive. It is part of the power supply module.
Input Current	Drive input current: 10.6A continuous and 21.2A peak	

Input Control Supply	> Control supply input voltage:
	  > Nominal voltage: 24 Vdc
	  > Minimum voltage: 19 Vdc
	  > Maximum voltage: 29 Vdc
	> Control supply input power: 15 W max.
	> Control supply input current:
	0.8 A max. @ 19 V control supply input voltage	

Power Bridge architecture	Three phase PWM bridge	
Output Power	Output power @100Vdc supply: 1066W continuous and 1977W peak	
Output Current (Cont./Peak) [A]	15/30	

	Description	Remarks
Maxi. drive output voltage (phase to phase) @ max bus voltage and nominal current, sine amplitude [V] For a given Bus Motor Supply Voltage [VM-DC]	Vm-dc X 88%	
Drive Protection	> Over voltage > Supply missing > 24 Vdc control supply missing > Phase-to-phase short circuit > Short to ground > Over current > Over temperature protection	

3.3.2.2 DDM3U-1-320V-15A-NP Motor Drive

The DDM3U-1-100V-15A-NP is a rack mounted single-axis PWM digital universal drive.

The SPiiPlusNT/DC motion controller, via the Controller- Drive interface, controls the drive output current.

The following motor types can be connected to drive:

- DC Brushless
- AC Induction
- DC Brush

3.3.2.2.1 DDM3U-1-320V-XXA-NP Specifications

DDM3U-1-100V-XXA-NP Specifications

	Description	Remarks
Supported motor types	Brush, Brushless or Induction.	
Number of axes supported	One	

	Description	Remarks
Axis designations	19" MC4U and 22" MC4U: X	
Input Voltage	Drive supply input voltage range: > Nominal: 24Vdc - 100Vdc > Minimal: 21Vdc (24Vdc - 10%) > Maximum: 105Vdc (100Vdc +5%)	
Input Power	Drive supply input power @100Vdc: 1139W continuous and 2190W peak.	During motor regeneration a rapid increase in the input voltage up to 130V is allowed. If the voltage ripple during regeneration exceeds this 130V, then the over voltage protection is activated. There is no regeneration circuit implemented in the DDM3U-1-100V-XXA-NP drive. It is part of the power supply module.
Input Current	Drive input current: 11.39A continuous and 21.90A peak	

	Description	Remarks
Input Control Supply	> Control supply input voltage: > Nominal voltage: 24 Vdc > Minimum voltage: 19 Vdc > Maximum voltage: 29 Vdc > Control supply input power: 15 W max. > Control supply input current: 0.8 A max. @ 19 V control supply input voltage	
Power Bridge architecture	Three phase PWM bridge	
Output Power	Output power @100Vdc supply: 1066W continuous and 1977W peak	
Output Current (Cont./Peak) [A]	15/30	
Maxi. drive output voltage (phase to phase) @ max bus voltage and nominal current, sine amplitude [V] For a given Bus Motor Supply Voltage [VM-DC]	Vm-dc X 88%	
Drive Protection	> Over voltage > Supply missing > 24 Vdc control supply missing > Phase-to-phase short circuit > Short to ground > Over current > Over temperature	

	Description	Remarks
	protection	

3.3.3 LDM3U Single Axis Linear Drive

The LDM3U is a single axis linear servo drive with digitally controlled current loop.

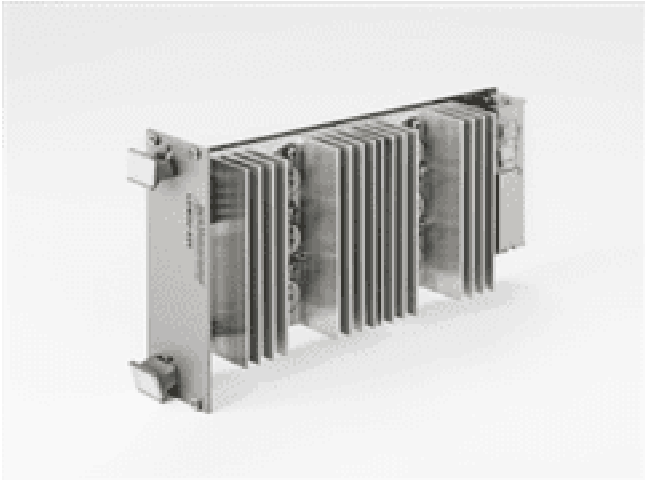


Figure 3-5. LDM3U Single Axis Linear Amplifier

The drive can be used with the following type of motors:

> DC Brushless

> DC Brush

The LDM3U can only be installed in the MC4U-19-Piano-enc. When installed, the LDM3U requires the MB5U-Lin or MB5U-LinM motherboard (MB5U-Lin and MB5U-LinM).

The main features of the LDM3U are as follows:

> Programmable Digital Current Loop bandwidth: Adjustable up to 5 kHz Commutation type: Sinusoidal. Initialization with and without Hall sensors.

> Fully protected against over and under voltage, over- current, under-current and over heating

> Built-in motor dynamic braking is automatically activated when the amplifier is disabled

> HW identification and fault diagnostic via I^2C interface

The following additional options are available upon request:

> Analog current loop control.

> Special digital control algorithm to increase maximum speed.

The LDM3U is supplied in the following versions:

> LDM3U-28V-8A-D

- LDM3U-28V-16A-D
- LDM3U-55V-8A-D
- LDM3U-55V-16A-D
- LDM3U-55V-16A-S
- LDM3U-55V-25A-S

3.3.3.1 LDM3U Specifications

Specification	LDM3U-28V-8A-D	LDM3U-28V-16A-D	LDM3U-55V-8A-D	LDM3U-55V-16A-D	LDM3U-55V-16A-S	LDM3U-55V-25A-S
Control & Logic supply (Vl) [Vdc]	Received from motor supply					
Motor supply (Vm) min. / max. [Vdc][1]	24-32	24-32	45-60	45-55	45-55	45-55
Motor phase current cont./peak sine amplitude [A]	4 / 8	4 / 16	4 / 8	4 / 16	4 / 16	6.25 / 25
Phase current cont./peak RMS [A]	2.83 / 5.66	2.83 / 11.31	2.83 / 5.66	2.83 / 11.31	2.83 / 11.31	4.42 / 17.68
Peak current time [sec]	2	1.5	2	1.5	1.5	1
Max. drive output voltage [Vpeak]	22	22	43	43	49	49
Input power @ max. Vm & cont. / peak current [W]	136 / 272	136 / 543	257 / 513	233 / 933	233 / 933	365 / 1458
Max. output power at maximum Vm & cont. / peak current [W]	81 / 162	81 / 324	166 / 333	150 / 600	173 / 693	271 / 1083
Min. load Inductance [mH]	0	0	0	0	0	0
Min. load resistance per phase [ʎ„¦]	0	0.075	0.45	0.73	0.73	0.78
Max. heat dissipation, cont / peak [W]	130 / 248	130 / 447	238 / 442	212 / 588	212 / 588	312 / 615

Specification	LDM3U-28V-8A-D	LDM3U-28V-16A-D	LDM3U-55V-8A-D	LDM3U-55V-16A-D	LDM3U-55V-16A-S	LDM3U-55V-25A-S
Dimensions: Height, Width, Length [mm]	128 X 46 X 246					
Weight [gr.]	830					

[1]Motor supply is provided in the MC4U enclosure by PSM3U drive supply module

3.4 MC4U Power Dissipation

The following table provides the power dissipation of the modules for both the low and high-power versions of the MC4U.

Table 3-49. MC4U Power Dissipation @ Nominal Load

Component	Heat Dissipation
SPiiPlusNT-LT Motion Controller	14W
SPiiPlusNT-HP Motion Controller	18W
SPiiPlusDC-LT Motion Controller	9W
SPiiPlusDC-HP Motion Controller	13W
PSM3U-48V-0.7kW Power Supply	85W
PSM3U-100V-3Kw Power Supply	100W
PSM3U-320V-4kW Power Supply	70W
PSM3U-320V-8kW Power Supply	135W
PSM3U-320V-10kW Power Supply	235W
PSM3U-320V-11kW Power Supply	186W
PSM3U-320V-20kW Power Supply	470W
DDM3U-4-06-02 Motor Drive	25W
DDM3U-2-320V-5A Motor Drive	87W (for 2 axes)
DDM3U-2-320V-10A Motor Drive	138W (for 2 axes)
DDM3U-2-320V-15A Motor Drive	226W (for 2 axes)
DDM3U-2-30-20 Motor Drive	212W (for axis 1 - nominal load, and axis 2 - half load)
DDM3U-4-320V-1A Motor Drive	25W
DDM3U-4-320V-2A Motor Drive	45W
DDM3U-4-320V-3A Motor Drive	62W
DDM3U-1-320V-30A-SR Motor Drive	235W
DDM3U-1-320V-45A-SR Motor Drive	346W

4. MC4U Connectivity

The type of connectors a MC4U has depends on the type of motherboard(s) it has (refer to the MC4U configuration file or quotation file to determine this for a given MC4U). A MC4U can have either one or multiple motherboards. When a MC4U has one motherboard, it is referred to as a System Motherboard. When a MC4U has multiple motherboards, they are referred to as Individual Motherboards. MC4Us with Individual Motherboards always have one motherboard for the controller and power supply modules (see Controller and Power Supply), and one or more motherboards for the drive modules (see Drive Module). A MC4U with a 9”, 11”, or 13” enclosures can only have a System Motherboard. A MC4U with a 19” or 22” enclosure can have either a System Motherboard, or Individual Motherboards.

4.1 MC4U Motherboards

A MC4U can have either one or multiple motherboards. When a MC4U has one motherboard, it is referred to as a System Motherboard. When a MC4U has multiple motherboards, they are referred to as Individual Motherboards. MC4Us with Individual Motherboards always have 1 motherboard for the controller and power supply modules, and 1 or more motherboards for the drive modules. A MC4U with a 9”, 11”, or 13” enclosures can only have a System Motherboard. A MC4U with a 19” or 22” enclosure can have either a System Motherboard, or Individual Motherboards.

The type of connectors a MC4U has depends on the type of motherboard(s) it has You may refer to the MC4U configuration file or quotation file to determine this for a given MC4U.

This section provides details of the motherboards installed in the various MC4U Control Module models. For each motherboard the supported functions are listed, details of each interface connector associated with the motherboard are provided, along with jumper settings.

4.2 System Motherboards

4.2.1 MB5U-Z

The MB5U-Z is installed in the MC4U-9-Piano-enc.

The connectors associated with the MB5U-Z are shown in the following figure.

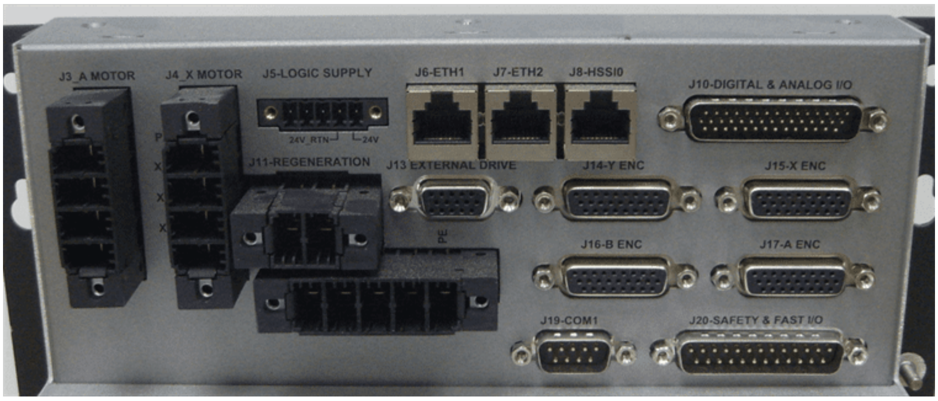


Figure 4-1. MB5U-Z Connectors

4.2.1.1 MB5U-Z Functionality

The MB5U-Z accommodates any SPiiPlus motion controller, one DDM3U-X-320V-XX (up to 20A/40A) drive and one PSM3U-X-XkW power supply. It supports the following functionality:

- 4 x Digital encoders
- 4 x SIN-COS encoders (optional)
- 4 x Hall effect sensors
- 4 x Motor Temperature sensors
- 8 x Safety inputs
- 1 x E-stop
- 8 x Digital outputs/Mechanical brakes
- 8 x Digital inputs
- 2 x Analog inputs if a 6-axis SPiiPlus High Performance controller is installed, or
  4 x Analog inputs if an 8-axis SPiiPlus High Performance controller is installed
- 2 x MARK signals
- 2 x PEG signals
- 2 x Motor output signals
- 2 x Ethernet channels
- 1 x HSSI channel
- 1 x RS-232 channel
- 2 x External Drive Control (Y & B)

4.2.1.2 Encoder and Hall Connectors

Label	J14-Y(1) ENC J15-X(0) ENC J16-B(3) ENC J17-A(2) ENC
Connector Type	D-type 26-pin HD female
Mating Type	D-type 26-pin HD male (for easy prototyping a Phoenix FLKM HDSUB-26/M Sub-D to Screw Terminal converter can be used)

The connectors are allocated as follows:

Connector	Axis	Connector	Axis
J15 - X ENC	X(0)	J17 - A ENC	A(2)
J14 - Y ENC	Y(1)	J16 - B ENC	B(3)

The pinout for the Encoder and Hall connectors is given in the following table:

> The dollar sign ($) stands for the given axis, for example, $_LL can be X_LL, or Y_LL, etc.

Table 4-1. Encoder/Hall Connector Pinout

Pin	Signal Designator	Description
1	$_CHA-	Encoder A(2) inverted input
2	$_CHB-	Encoder B(3) inverted input
3	$_CHI-	Encoder index inverted input
4	$_HB	Motor Hall B
5	V_SUP_SFTY	Supply for the limits input
6	$_RL	Right limit
7	$_SIN-	Encoder SIN inverted input
8	$_COS-	Encoder COS inverted input
9	$_SC_I-	Encoder SIN-COS Index inverted input
10	$_CHA+	Encoder A(2) non-inverted input
11	$_CHB+	Encoder B(3) non-inverted input
12	$_CHI+	Encoder Index non-inverted input
13	$_HA	Motor Hall A
14	$_HC	Motor Hall C
15	$_LL	Left limit
16	$_SIN+	SIN non-inverted input

Pin	Signal Designator	Description
17	$_COS+	Encoder COS non-inverted input
18	$_SC_I+	Encoder SIN-COS Index non-inverted input
19	5U	5V user supply for the digital encoder and Hall sensor
20	5U_RTN	5V return user supply for the digital encoder and Hall sensor
21	Shield	Shield
22	$_MTMP	Motor temperature sensor input
23	V_RTN_IO	A return for the motor temperature sensor
24	V_RTN_SFTY	A return for the limits input
25	5F	5V user supply for the analog encoder and Hall sensor
26	5F_RTN	5V return user supply for the analog encoder and Hall sensor

4.2.1.3 J10 - Digital and Analog I/O Connector

Label	J10 - DIGITAL & ANALOG I/O
Connector Type	D-type 44-pin HD male
Mating Type	D-type 44-pin HD female (for easy prototyping a Phoenix FLKM HDSUB-44/M Sub-D to Screw Terminal converter can be used)

The connector serves for controlling Digital and Analog I/O signal formats. The pinout for J10 is given in the following table:

Table 4-2. J10 - Digital and Analog I/O Pinout

Pin #	Signal Designator	Description
1	OUT1	Digital Output 1
2	OUT3	Digital Output 3
3	OUT5	Digital Output 5

Pin #	Signal Designator	Description
4	OUT7	Digital Output 7
5	IN1	Digital Input 1
6	IN3	Digital Input 3
7	AGND	Analog ground
8	AIN10-	Analog input AIN10 inverted
9	AIN11-	Analog input AIN11 inverted
10	AIN14-	Analog input AIN14 inverted
11	AIN15-	Analog input AIN15 inverted
12	AOUT10-	Analog output AOUT10 inverted
13	AOUT11-	Analog output AOUT11 inverted
14	AOUT14-	Analog output AOUT114 inverted
15	AOUT15-	Analog output AOUT15 inverted
16	OUT0	Digital Output 0
17	OUT2	Digital Output 2
18	OUT4	Digital Output 4
19	OUT6	Digital Output 6
20	IN0	Digital Input 0
21	IN2	Digital Input 2
22	-	Not connected
23	AIN10+	Analog input AIN10 non-inverted
24	AIN11+	Analog input AIN11 non-inverted
25	AIN14+	Analog input AIN14 non-inverted
26	AIN15+	Analog input AIN15 non-inverted

Pin #	Signal Designator	Description
27	AOUT10+ (AOUT2+)	Analog output AOUT10 non-inverted
28	AOUT11+ (AOUT6+)	Analog output AOUT11 non-inverted
29	AOUT14+ (AOUT10+)	Analog output AOUT14 non-inverted
30	AOUT15+ (AOUT14+)	Analog output AOUT15 non-inverted
31	V_SUP_IO	Input/Output Supply+
32	V_RTN_IO	Input/Output Supply Return
33	IN4/Z_MARK2	Digital Input 4 (can also be used for Z_MARK2)
34	IN5/T_MARK2	Digital Input 5 (can also be used for T_MARK2)
35	IN6/X_MARK2	Digital Input 6 (can also be used for X_MARK2)
36	IN7/Y_MARK2	Digital Input 7 (can also be used for Y_MARK2)
When employing IN4, IN5, IN6 and/or IN7 for MARK2, the normal delay for Digital Input (< 0.3 μSec) increases to 50 μSec.		
37	AGND	Analog ground
38	AGND	Analog ground
39	-	Not connected
40	-	Not connected
41	-	Not connected
42	-	Not connected

Pin #	Signal Designator	Description
43	-	Not connected
44	-	Not connected

4.2.1.4 J20 - Safety & Fast I/O Inputs Connector

Label	J20 - SAFETY & FAST I/O
Connector Type	D-type 25-pin male
Mating Type	D-type 25-pin female (for easy prototyping a Phoenix FLKM HDSUB-25/M Sub-D to Screw Terminal converter can be used)

The connector serves for controlling Safety and Fast I/O input signals. The pinout for J20 is given in the following table:

Table 4-3. J20 - Safety and Fast I/O Pinout

Pin	Signal Designator	Description
1	V_SUP_SFTY	Safety Supply +
2	-	Not Connected
3	X_LL	X(0) Left Limit
4	A_LL	A(2) Left Limit
5	Y_LL	Y(1) Left Limit
6	B_LL	B(3) Left Limit
7	DGND	Digital ground
8	Y_MARK1+	Non-inverted MARK1 for 1(Y) axis
9	X_MARK1+	Non-inverted MARK1 for 0(X) axis
10	Y_PEG+	Non-inverted PEG for 1(Y) axis
11	X_PEG+	Non-inverted PEG for 0(X) axis
12	-	Not Connected
13	-	Not Connected

Pin	Signal Designator	Description
14	V_RTN_SFTY	Safety Supply Return
15	-	Not Connected
16	X_RL	X(0) Right Limit
17	A_RL	A(2) Right Limit
18	Y_RL	Y(1) Right Limit
19	B_RL	B(3) Right Limit
20	Y_MARK1-	Inverted MARK1 for Y(1) axis
21	X_MARK1-	Inverted MARK1 for X(0) axis
22	Y_PEG-	Inverted PEG for Y(1) axis
23	X_PEG-	Inverted PEG forX(0) axis
24	ES+	Non-inverted Emergency Stop
25	ES-	Inverted Emergency Stop

4.2.1.5 J3, J4 - Drive Motor Connectors

Label	J3_A MOTOR
	J4_X MOTOR
Connector Type	Phoenix PCV 4/4-G-7,62-BK
Mating Type	Phoenix PC 4/ 4-STF-7,62

They serve for connecting the A axis drive motor and the X axis drive motor, respectively, to the controller. The pinout of the connectors is given in the following table:

The dollar sign ($) stands for the given axis, for example, $_R can be A_R, or X_R, etc.

Table 4-4. J3 and J4 - Drive Motor Pinout

Pin #	Signal Designator	Description
1	EGND	Shield
2	$_R	Motor R phase
3	$_S	Motor S phase
4	$_T	Motor T phase

The following diagrams illustrate how motors are to be connected:

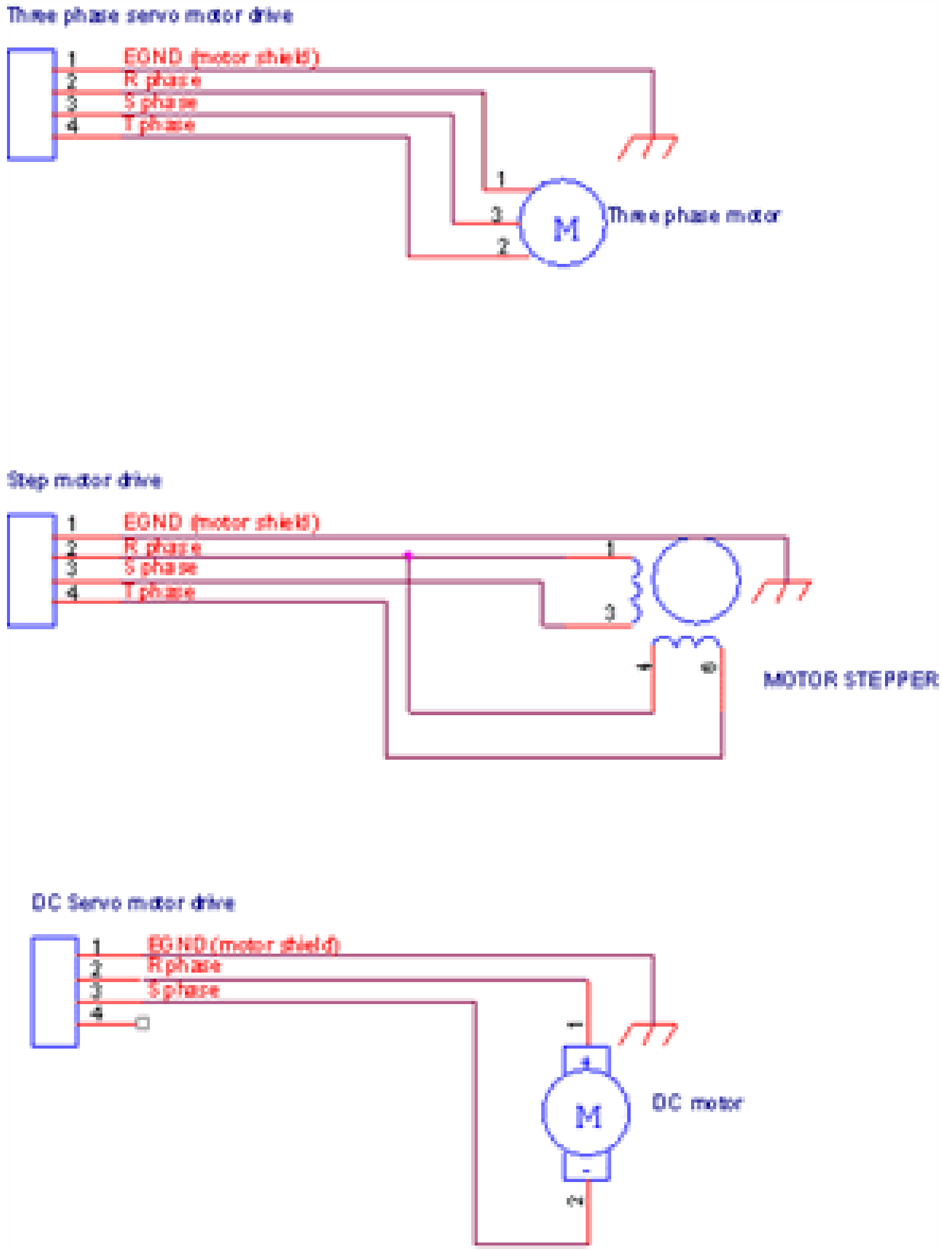


Figure 4-2. MB5U-Z Motor Drive Connections

4.2.1.6 J6 and J7 - Ethernet Connectors

Label	J6 - ETH1 J7 - ETH2
Connector Type	RJ45 8-pin socket
Mating Type	RJ45 8-pin plug

The J6/J7 pinout is given in the following table:

Table 4-5. J6 and J7 - Ethernet Pinout

Pin #	Signal Designator	Description
1	ETH$_TX+	Positive transmit signal
2	ETH$_TX -	Negative transmit signal
3	ETH$_RX +	Positive receive signal
4	-	Not connected
5	-	Not connected
6	ETH$_RX -	Negative receive signal
7	-	Not connected
8	-	Not connected

4.2.1.7 J8 - HSSI Connector

Label	J8 - HSSI0
Connector Type	RJ45 8-pin socket
Mating Type	RJ45 8-pin plug

The pinout of J8 is given in the following table:

Table 4-6. J8 - HSSI Pinout

Pin #	Signal Designator	Description
1	CONTROL_$+	Control signal non-inverted output for channel 0
2	CONTROL_$-	Control signal inverted output for channel 0
3	SER_DI_$+	Serial data non-inverted input for channel 0
4	SER_DI_$-	Serial data inverted input for channel 0
5	SER_DO_$+	Serial data non-inverted output for channel 0
6	SER_DO_$-	Serial data inverted output for channel 0
7	DGND	Digital ground for 5L
8	DGND	Digital ground for 5L

4.2.1.8 J19 - RS-232 Serial Communication Connector

Label	J19 - COM1
Connector Type	D-type 9-pin male
Mating type	D-type 9-pin female

> The MC4U 9" and 11" do not have a COM2 port. Field recovery is not possible; to recover the controller firmware contact ACS.

The pinout of J19 is given in the following table:

Table 4-7. J19 - RS-232 Communication Pinout

Pin #	Signal Designator	Description
1	SHIELD	Cable shield connection
2	RX232	RS-232 receive signal for the serial communication port (COM1)
3	TX232	RS-232 transmit signal for serial communication port (COM1).
4	-	Not connected
5	DGND	Digital ground.
6	-	Not connected
7	-	Not connected
8	-	Not connected
9	-	Not connected

4.2.1.9 J13 - External Drive Control Signals

Label	J13 EXTERNAL DRIVE
Connector Type	D-type HD 15-pin female
Mating Type	D-type HD 15-pin male

J13 serves for connecting an external drive.

It is possible to use external drives and control two additional axes, designated Y and B, through J13. In this case, the interface to both drives is through J13; however, for encoder feedback you have to use connectors J14 (for the Y axis) and J16 (for the B axis).

The pinout of J13 is given in the following table:

Table 4-8. J13 - External Drive Control Signals Pinout

Pin #	Signal Designator	Description
1	Y_CMD0+	Y Drive Command 0+
2	Y_CMD0-	Y Drive Command 0-
3	Y_CMD1+	Y Drive Command 1+
4	Y_CMD1-	Y Drive Command 1-
5	Y_ENA	Y axis enable signal
6	B_CMD0+	B Drive Command 0+
7	B_CMD0-	B Drive Command 0-
8	B_CMD1+	B Drive Command 1+
9	B_CMD1-	B Drive Command 1-
10	Y_FLT	Y axis fault signal
11	AGND	Analog Ground
12	DGND	Digital Ground
13	5U	5V user supply for digital encoder and Hall sensor
14	B_ENA	B axis enable signal
15	B_FLT	B axis fault signal

Drive Enable Example

The following example illustrates the drive enable interface for a B axis direct-connected servo drive. The same interface applies for direct-connected stepper drives.

The value of the pull-up or pull-down resistor must ensure that the enable output current does not exceed the controller's rated maximum current (50mA).

The following illustration is an example (for the B axis) of an enable output connection to a **source-type** input on a servo drive, the drive having **internal** pull-down resistor. When the drive receives external volt (up to 24Vdc), it becomes enabled.

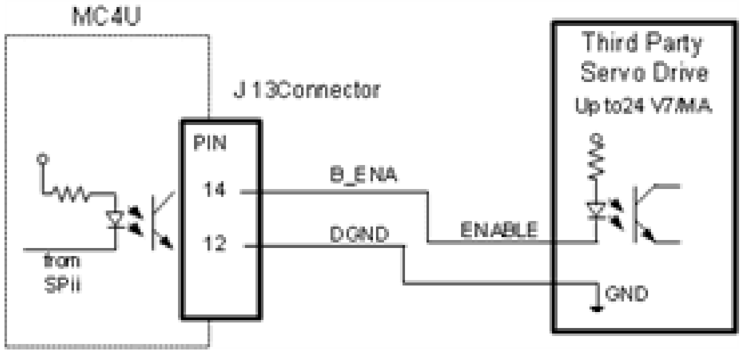


Figure 4-3. Source -Type Drive Enable Output (B Axis)

4.2.1.10 J11 - External Regeneration

Label	J11 - EXTERNAL REGENERATION
Connector Type	Phoenix PCV 5/ 2-GF-7,62
Mating Type	Phoenix PC 5/ 2-STF-7,62

The pinout for J11 is given in the following table:

Table 4-9. J11 - External Regeneration Pinout

Pin	Signal Designator	Description
1	REG1	External Regeneration resistor terminal 1
2	REG2	External Regeneration resistor terminal 2

4.2.1.11 J12 - Drive Supply Connector

Label	J12 - DRIVE SUPPLY
Connector Type	Phoenix PCV 5/ 5-GF-7,62
Mating Type	Phoenix PC 5/ 5-STF-7,62

AC power is provided through J12. The pinout is given in the following table:

Table 4-10. J12 - Drive Supply Pinout

Pin #	Signal Designator	Description
1	L1	AC input phase L1
2	L2	AC input phase L2 (Neutral when using a single-phase power supply)
3	L3	AC input phase L3
4	-	Not Connected
5	EGND	Earth Ground (shield)

4.2.1.12 J5 - 24V Logic Supply Connector

Label	J5 - 24V LOGIC SUPPLY
Connector Type	Phoenix MCV-1.5/5 GF 3.81 connector
Mating Type	Phoenix MC-1.5/5 STF- 3.81

24Vdc is provided through J5. The pinout of J5 is given in the following table:

Table 4-11. J5 - 24V Logic Supply Pinout

Pin #	Signal Designator	Description
1	24V_SUP	24V logic supply
2	24V_RTN	24V logic supply return
3	5V_ENC_EXT	External 5V supply for encoder
4	5V_ENC_EXT_RTN	External 5V supply return for encoder
5	EGND	Earth Ground (shield)

4.2.1.13 MB5U-Z Jumper Configuration

This section details the settings of the MB5U-Z jumpers.

Only a qualified technician should make any changes to the factory settings of the jumpers. Remove the back cover of the unit to access the jumpers.

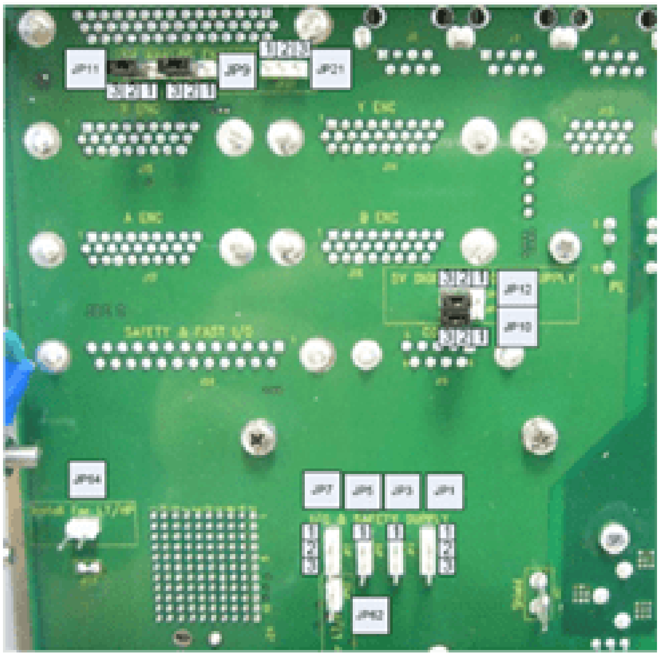


Figure 4-4. MB5U-Z Motherboard Jumpers and Pin Numbers

Table 4-12. I/O Jumpers

Setup	JP1	JP3	JP5	JP7
I/O supply external	N/A	Remove	Remove	N/A
I/O supply internal 5V	N/A	1-2	1-2	N/A
I/O supply internal 24V	N/A	2-3	2-3	N/A
Safety supply external	Remove	N/A	N/A	Remove
Safety supply internal 5V	1-2	N/A	N/A	1-2
Safety supply internal 24V	2-3	N/A	N/A	2-3

If an internal power supply is used for safety or I/O, do not connect an external power supply to the V_SUP_SFTY/V_RTN_SFTY of the Encoder connectors or the OUT of the Digital Output connectors.

When using the 5V internal supply for digital I/O or Safety, these I/Os are not isolated.

Table 4-13. Encoder Supply

Setup	JP9	JP10	JP11	JP12	JP21
Analog encoder external supply	1-2	N/A	1-2	N/A	1-2
Analog encoder internal supply	2-3	N/A	2-3	N/A	Open
Digital encoder external supply	N/A	1-2	N/A	1-2	2-3
Digital encoder internal supply	N/A	2-3	N/A	2-3	Open

Table 4-14. Default Jumper Settings

Jumper	Setting
JP1	Open
JP3	Open
JP5	Open
JP7	Open
JP9	2-3
JP10	2-3
JP11	2-3
JP12	2-3
JP21	2-3

4.2.2 MB5U-ZZ

The MB5U-ZZ is installed in the MC4U-11-Piano-enc.

The connectors associated with the MB5U-ZZ are shown in the following figure:

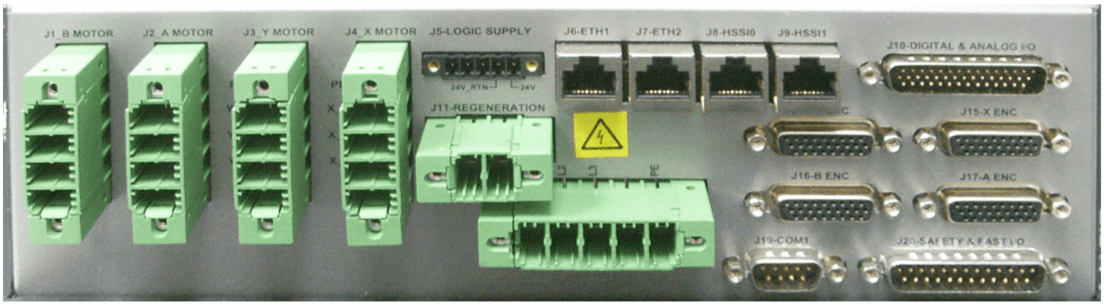


Figure 4-5. MB5U-ZZ Connectors

4.2.2.1 MB5U-ZZ Functionality

The MB5U-ZZ accommodates any SPiiPlus motion controller, two DDM3U-2-320V-XX drives and one PSM3U-X-XkW power supply. It supports the following functionality:

- 4 x Digital encoders
- 4 x SIN-COS encoders (optional)
- 4 x Hall effect sensors
- 4 x Motor Temperature sensors
- 8 x Safety inputs
- 1 x E-stop
- 8 x Digital outputs/Mechanical brakes
- 8 x Digital inputs
- 2 x Analog inputs if the 6-axis High Performance controller is installed, or

4 x Analog inputs if the 8-axis High Performance controller is installed

- 2 x MARK signals
- 2 x PEG signals
- 4 x Motor output signals
- 2 x Ethernet channels
- 2 x HSSI channels
- 1 x RS-232 channel

4.2.2.2 Encoder and Hall Connectors

Label	J14-Y(1) ENC
	J15-X(0) ENC
	J16-B(3) ENC
	J17-A(2) ENC

Connector Type	D-type 26-pin HD female
Mating Type	D-type 26-pin HD male (for easy prototyping a Phoenix FLKM HDSUB-26/M Sub-D to Screw Terminal converter can be used)

The connectors are allocated as follows:

Connector	Axis	Connector	Axis
J15 - X ENC	X(0)	J17 - A ENC	A(2)
J14 - Y ENC	Y(1)	J16 - B ENC	B(3)

The pinout for the Encoder and Hall connectors is given in the following table:

The dollar sign ($) stands for the given axis, for example, $_LL can be X_LL, or Y_LL, etc.

Table 4-15. Encoder/Hall Connector Pinout

Pin	Signal Designator	Description
1	$_CHA-	Encoder A(2) inverted input
2	$_CHB-	Encoder B(3) inverted input
3	$_CHI-	Encoder index inverted input
4	$_HB	Motor Hall B
5	V_SUP_SFTY	Supply for the limits input
6	$_RL	Right limit
7	$_SIN-	Encoder SIN inverted input
8	$_COS-	Encoder COS inverted input
9	$_SC_I-	Encoder SIN-COS Index inverted input
10	$_CHA+	Encoder A(2) non-inverted input
11	$_CHB+	Encoder B(3) non-inverted input

Pin	Signal Designator	Description
12	$_CHI+	Encoder Index non-inverted input
13	$_HA	Motor Hall A
14	$_HC	Motor Hall C
15	$_LL	Left limit
16	$_SIN+	SIN non-inverted input
17	$_COS+	Encoder COS non-inverted input
18	$_SC_I+	Encoder SIN-COS Index non-inverted input
19	5U	5V user supply for the digital encoder and Hall sensor
20	5U_RTN	5V return user supply for the digital encoder and Hall sensor
21	Shield	Shield
22	$_MTMP	Motor temperature sensor input
23	V_RTN_IO	A return for the motor temperature sensor
24	V_RTN_SFTY	A return for the limits input
25	5F	5V user supply for the analog encoder and Hall sensor
26	5F_RTN	5V return user supply for the analog encoder and Hall sensor

4.2.2.3 J10 - Digital and Analog I/O Connector

Label	J10 - DIGITAL & ANALOG I/O
Connector Type	D-type 44-pin HD male
Mating Type	D-type 44-pin HD female (for easy prototyping a Phoenix FLKM HDSUB-44/M Sub-D to Screw Terminal converter can be used)

J10 serves for controlling Digital and Analog I/O signal formats. The pinout for J10 is given in the following table:.

Table 4-16. J10 - Digital and Analog I/O Pinout

Pin #	Signal Designator	Description
1	OUT1 (BRAKE_Y)	Digital Output 1 (Mechanical Brake for Y axis)
2	OUT3 (BRAKE_T)	Digital Output 3 (Mechanical Brake for T axis)
3	OUT5 (BRAKE_B)	Digital Output 5 (Mechanical Brake for B axis)
4	OUT7 (BRAKE_D)	Digital Output 7 (Mechanical Brake for D axis)
5	IN1	Digital Input 1
6	IN3	Digital Input 3
7	AGND	Analog ground
8	AIN10-	Analog input AIN10 inverted
9	AIN11-	Analog input AIN11 inverted
10	AIN14-	Analog input AIN14 inverted
11	AIN15-	Analog input AIN15 inverted
12	AOUT10-	Analog output AOUT10 inverted
13	AOUT11-	Analog output AOUT11 inverted
14	AOUT14-	Analog output AOUT14 inverted
15	AOUT15-	Analog output AOUT15 inverted
16	OUT0 (BRAKE_X)	Digital Output 0 (Mechanical Brake for X axis)
17	OUT2 (BRAKE_Z)	Digital Output 2 (Mechanical Brake for Z axis)
18	OUT4 (BRAKE_A)	Digital Output 4 (Mechanical Brake for A axis)

Pin #	Signal Designator	Description
19	OUT6 (BRAKE_C)	Digital Output 6 (Mechanical Brake for C axis)
20	IN0	Digital Input 0
21	IN2	Digital Input 2
22	-	Not connected
23	AIN10+	Analog input AIN10 non-inverted
24	AIN11+	Analog input AIN11 non-inverted
25	AIN14+	Analog input AIN14 non-inverted
26	AIN15+	Analog input AIN15 non-inverted
27	AOUT10+ (AOUT2+)	Analog output AOUT10 non-inverted
28	AOUT11+ (AOUT6+)	Analog output AOUT11 non-inverted
29	AOUT14+ (AOUT10+)	Analog output AOUT14 non-inverted
30	AOUT15+ (AOUT14+)	Analog output AOUT15 non-inverted
31	V_SUP_IO	Input/Output Supply+
32	V_RTN_IO	Input/Output Supply Return
33	IN4/Z_MARK2	Digital Input 4 (can also be used for Z_MARK2)
34	IN5/T_MARK2	Digital Input 5 (can also be used for T_MARK2)
35	IN6/X_MARK2	Digital Input 6 (can also be used for X_MARK2)
36	IN7/Y_MARK2	Digital Input 7 (can also be used for Y_MARK2)

Pin #	Signal Designator	Description
When employing IN4, IN5, IN6 and/or IN7 for MARK2, the normal delay for Digital Input (< 0.3 μSec) increases to 50 μSec.		
37	AGND	Analog ground
38	AGND	Analog ground
39	-	Not connected
40	-	Not connected
41	-	Not connected
42	-	Not connected
43	-	Not connected
44	-	Not connected

4.2.2.4 J20 - Safety & Fast I/O Inputs Connector

Label	J20 - SAFETY & FAST I/O
Connector Type	D-type 25-pin male
Mating Type	D-type 25-pin female (for easy prototyping a Phoenix FLKM HDSUB-25/M Sub-D to Screw Terminal converter can be used)

The connector serves for controlling Safety and Fast I/O input signals. The pinout for J20 is given in the following table:

Table 4-17. J20 - Safety and Fast I/O Pinout

Pin	Signal Designator	Description
1	V_SUP_SFTY	Safety Supply +
2	-	Not Connected
3	X_LL	X(0) Left Limit
4	A_LL	A(2) Left Limit

Pin	Signal Designator	Description
5	Y_LL	Y(1) Left Limit
6	B_LL	B(3) Left Limit
7	DGND	Digital ground
8	Y_MARK1+	Non-inverted MARK1 for 1(Y) axis
9	X_MARK1+	Non-inverted MARK1 for 0(X) axis
10	Y_PEG+	Non-inverted PEG for 1(Y) axis
11	X_PEG+	Non-inverted PEG for 0(X) axis
12	-	Not Connected
13	-	Not Connected
14	V_RTN_SFTY	Safety Supply Return
15	-	Not Connected
16	X_RL	X(0) Right Limit
17	A_RL	A(2) Right Limit
18	Y_RL	Y(1) Right Limit
19	B_RL	B(3) Right Limit
20	Y_MARK1-	Inverted MARK1 for Y(1) axis
21	X_MARK1-	Inverted MARK1 for X(0) axis
22	Y_PEG-	Inverted PEG for Y(1) axis
23	X_PEG-	Inverted PEG forX(0) axis
24	ES+	Non-inverted Emergency Stop
25	ES-	Inverted Emergency Stop

4.2.2.5 J1, J2, J3, J4 - Drive Motor Connectors

Label	J1_B(3) MOTOR
	J2_A(2) MOTOR
	J3_Y(1) MOTOR
	J4_X(0) MOTOR
Connector Type	Phoenix PCV 4/4-G-7,62-BK
Mating Type	Phoenix PC 4/ 4-STF-7,62

They serve for connecting the B(3) axis drive motor, A(2) axis drive motor, Y(1) axis drive motor, and the X(0) axis drive motor, respectively, to the controller.

The pinout of the connectors is given in the following table:

The dollar sign ($) stands for the given axis, for example, $_R can be A_R, X_R, etc.

Table 4-18. J1, J2, J3 and J4 - Drive Motor Pinout

Pin #	Signal Designator	Description
1	EGND	Shield
2	$_R	Motor R phase
3	$_S	Motor S phase
4	$_T	Motor T phase

The following diagrams illustrate how motors are to be connected.

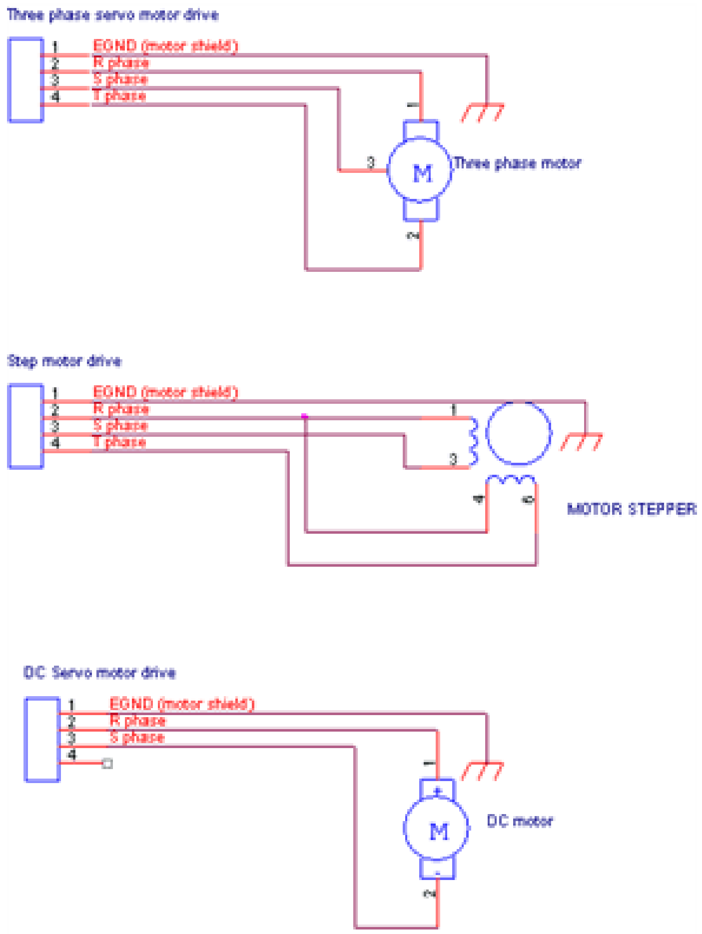


Figure 4-6. MB5U-ZZ Motor Drive Connections

4.2.2.6 J6 and J7 - Ethernet Connectors

Label	J6 - ETH1
	J7 - ETH2
Connector Type	RJ45 8-pin socket
Mating Type	RJ45 8-pin plug

The J6/J7 pinout is given in the following table:

Table 4-19. J6 and J7 - Ethernet Pinout

Pin #	Signal Designator	Description
1	ETH$_TX+	Positive transmit signal
2	ETH$_TX -	Negative transmit signal
3	ETH$_RX +	Positive receive signal

Pin #	Signal Designator	Description
4	-	Not connected
5	-	Not connected
6	ETH$_RX -	Negative receive signal
7	-	Not connected
8	-	Not connected

4.2.2.7 J8 and J9 - HSSI Connectors

Label	J8 - HSSI0 (X(0) & A(2) axes)
	J9 - HSSI1 (Y(1) & B(3) axes)
Connector Type	RJ45 8-pin sockets
Mating Type	RJ45 8-pin plug

The pinout of the sockes is given in the following table:

Table 4-20. J8 and J9 - HSSI Pinout

Pin #	Signal Designator	Description
1	CONTROL_$+	Control signal non-inverted output for channel 0
2	CONTROL_$-	Control signal inverted output for channel 0
3	SER_DI_$+	Serial data non-inverted input for channel 0
4	SER_DI_$-	Serial data inverted input for channel 0
5	SER_DO_$+	Serial data non-inverted output for channel 0
6	SER_DO_$-	Serial data inverted output for channel 0
7	DGND	Digital ground for 5L
8	DGND	Digital ground for 5L

4.2.2.8 J19 - RS-232 Serial Communication Connector

Label	J19 - COM1
Connector Type	D-type 9-pin male

Mating type	D-type 9-pin female

The MC4U 9" and 11" do not have a COM2 port. Field recovery is not possible; to recover the controller firmware contact ACS.

The pinout of J19 is given in the following table:

Table 4-21. J19 - RS-232 Communication Pinout

Pin #	Signal Designator	Description
1	SHIELD	Cable shield connection
2	RX232	RS-232 receive signal for the serial communication port (COM1)
3	TX232	RS-232 transmit signal for serial communication port (COM1).
4	-	Not connected
5	DGND	Digital ground.
6	-	Not connected
7	-	Not connected
8	-	Not connected
9	-	Not connected

4.2.2.9 J11 - External Regeneration

Label	J11 - EXTERNAL REGENERATION
Connector Type	Phoenix PCV 5/ 2-GF-7,62
Mating Type	Phoenix PC 5/ 2-STF-7,62

The pinout for J11 is given in the following table:

Table 4-22. J11 - External Regeneration Pinout

Pin	Signal Designator	Description
1	REG1	External Regeneration resistor terminal 1
2	REG2	External Regeneration resistor terminal 2

4.2.2.10 J12 - Drive Supply Connector

Label	J12 - DRIVE SUPPLY
Connector Type	Phoenix PCV 5/ 5-GF-7,62
Mating Type	Phoenix PC 5/ 5-STF-7,62

AC power is provided through J12. The pinout is given in the following table:

Table 4-23. J12 - Drive Supply Pinout

Pin #	Signal Designator	Description
1	L1	AC input phase L1
2	L2	AC input phase L2 (Neutral when using a single-phase power supply)
3	L3	AC input phase L3
4	-	Not Connected
5	EGND	Earth Ground (shield)

4.2.2.11 J5 - 24V Logic Supply Connector

Label	J5 - 24V LOGIC SUPPLY
Connector Type	Phoenix MCV-1.5/5 GF 3.81 connector
Mating Type	Phoenix MC-1.5/5 STF- 3.81

24Vdc is provided through J5. The pinout of J5 is given in the following table:

Table 4-24. J5 - 24V Logic Supply Pinout

Pin #	Signal Designator	Description
1	24V_SUP	24V logic supply
2	24V_RTN	24V logic supply return
3	5V_ENC_EXT	External 5V supply for encoder
4	5V_ENC_EXT_RTN	External 5V supply return for encoder
5	EGND	Earth Ground (shield)

4.2.2.12 MB5U-ZZ Jumpers

This section details the settings of the MB5U-ZZ jumpers.

> Only a qualified technician should make any changes to the factory settings of the jumpers. Remove the back cover of the unit to access the jumpers.

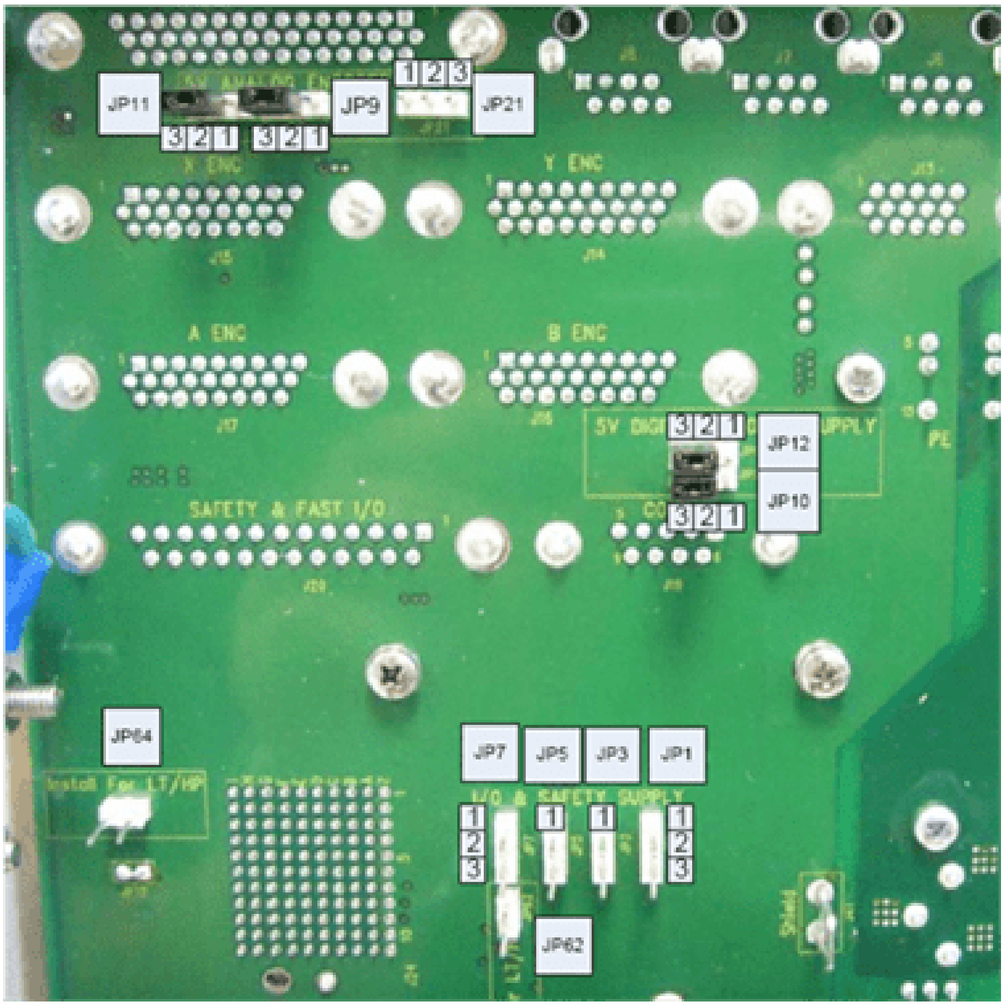


Figure 4-7. MB5U-ZZ Jumpers and Pin Numbers

Table 4-25. I/O Jumpers

Setup	JP1	JP3	JP5	JP7
I/O supply external	N/A	Remove	Remove	N/A
I/O supply internal 5V	N/A	1-2	1-2	N/A

Setup	JP1	JP3	JP5	JP7
I/O supply internal 24V	N/A	2-3	2-3	N/A
Safety supply external	Remove	N/A	N/A	Remove
Safety supply internal 5V	1-2	N/A	N/A	1-2
Safety supply internal 24V	2-3	N/A	N/A	2-3

If an internal power supply is used for safety or I/O, do not connect an external power supply to the V_SUP_SFTY/V_RTN_SFTY of the Encoder connectors or the OUT of the Digital Output connectors.

When using the 5V internal supply for digital I/O or Safety, these I/Os are not isolated.

Table 4-26. Encoder Supply

Setup	JP9	JP10	JP11	JP12	JP21
Analog encoder external supply	1-2	N/A	1-2	N/A	1-2
Analog encoder internal supply	2-3	N/A	2-3	N/A	Open
Digital encoder external supply	N/A	1-2	N/A	1-2	2-3
Digital encoder internal supply	N/A	2-3	N/A	2-3	Open

Table 4-27. Default Jumper Settings

Jumper	Setting
JP1	Open
JP3	Open

Jumper	Setting
JP5	Open
JP7	Open
JP9	2-3
JP10	2-3
JP11	2-3
JP12	2-3
JP21	2-3

4.2.3 MB5U-ZV

The MB5U-ZV is installed in the MC4U-11-Piano-enc.

The connectors associated with the MB5U-ZV are shown in the following figure:

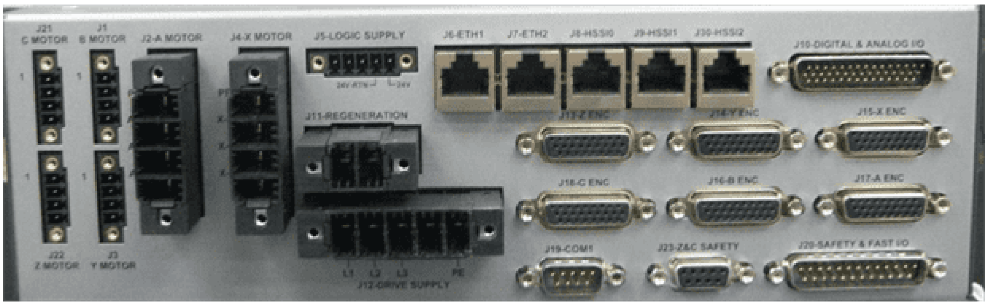


Figure 4-8. MB5U-ZV Connectors

4.2.3.1 MB5U-ZV Functionality

The MB5U-ZV accomodates any SPiiPlus motion controller, one DDM3U-2-320V-XX (up to 20A/40A) drive and one DDM3U-4-XX drive, and one PSM3U-X-XkW power supply.

It supports the following functionality:

- 6 x Digital encoders
- 6 x SIN-COS encoders (optional)
- 8 x Digital inputs/outputs
- 2 x Analog inputs if the 6-axis SPiiPlus High Performance controller is installed, or

4 x Analog inputs if the 8-axis SPiiPlus High Performance controller is installed

- 2 x Analog outputs
- 3 x MARK signals
- 3 x PEG signals
- 12 x Safety inputs

- 1 x E-stop
- 8 x Digital outputs/Mechanical brakes
- 6 x Motor output signals
- 2 x Ethernet channels
- 3 x HSSI channels
- 1 x RS-232 channel

4.2.3.2 *Encoder and Hall Connectors*

Label	J13-Z(4) ENC
	J14-Y(1) ENC
	J15-X(0) ENC
	J16-B(3) ENC
	J17-A(2) ENC
	J18-C(6) ENC
Connector Type	D-type 26-pin HD female
Mating Type	D-type 26-pin HD male (for easy prototyping a Phoenix FLKM HDSUB-26/M Sub-D to Screw Terminal converter can be used)

The connectors are allocated as follows:

Connector	Axis	Connector	Axis
J13 - Z ENC	Z(4)	J16 - B ENC	B(3)
J14 - Y ENC	Y(1)	J17 - A ENC	A(2)
J15 - X ENC	X(0)	J18 - C ENC	C(6)

The pinout for the Encoder/Hall Connectors is given in the following table:

> The dollar sign ($) stands for the given axis, for example, $_LL can be X_LL, or Y_LL, etc.

Table 4-28. Encoder/Hall Pinout

Pin	Signal Designator	Description
1	$_CHA-	Encoder A(2) inverted input
2	$_CHB-	Encoder B(3) inverted input
3	$_CHI-	Encoder index inverted input
4	$_HB	Motor Hall B
5	V_SUP_SFTY	Supply for the limits input
6	$_RL	Right limit
7	$_SIN-	Encoder SIN inverted input
8	$_COS-	Encoder COS inverted input
9	$_SC_I-	Encoder SIN-COS Index inverted input
10	$_CHA+	Encoder A(2) non-inverted input
11	$_CHB+	Encoder B(3) non-inverted input
12	$_CHI+	Encoder Index non-inverted input
13	$_HA	Motor Hall A
14	$_HC	Motor Hall C
15	$_LL	Left limit
16	$_SIN+	SIN non-inverted input
17	$_COS+	Encoder COS non-inverted input
18	$_SC_I+	Encoder SIN-COS Index non-inverted input
19	5U	5V user supply for the digital encoder and Hall
20	5U_RTN	5V return user supply for the digital encoder and Hall
21	Shield	Shield
22	$_MTMP	Motor temperature sensor input
23	V_RTN_IO	A return for the motor temperature sensor

Pin	Signal Designator	Description
24	V_RTN_SFTY	A return for the limits input
25	5F	5V user supply for the analog encoder and Hall
26	5F_RTN	5V return user supply for the analog encoder and Hall

4.2.3.3 J10 - Digital and Analog I/O Connector

Label	J10 - DIGITAL & ANALOG I/O
Connector Type	D-type 44-pin HD male
Mating Type	D-type 44-pin HD female (for easy prototyping a Phoenix FLKM HDSUB-44/M Sub-D to Screw Terminal converter can be used)

J10 serves for controlling Digital and Analog I/O signal formats. The pinout for J10 is given in the following table:

Table 4-29. J10 - Digital and Analog I/O Pinout

Pin #	Signal Designator	Description
1	OUT1	Digital Output 1
2	OUT3	Digital Output 3
3	OUT5	Digital Output 5
4	OUT7	Digital Output 7
5	IN1	Digital Input 1
6	IN3	Digital Input 3
7	AGND	Analog ground
8	AIN10-	Analog input AIN10 inverted
9	AIN11-	Analog input AIN11 inverted
10	AIN14-	Analog input AIN14 inverted (Applicable only in configurations supporting 8 axes)

Pin #	Signal Designator	Description
11	AIN15-	Analog input AIN15 inverted (Applicable only in configurations supporting 8 axes)
12	AOUT10-	Analog output AOUT10 inverted
13	AOUT11-	Analog output AOUT11 inverted
14	AOUT14-	Analog output AOUT14 inverted (Applicable only in configurations supporting 8 axes)
15	AOUT15-	Analog output AOUT15 inverted (Applicable only in configurations supporting 8 axes)
16	OUT0	Digital Output 0
17	OUT2	Digital Output 2
18	OUT4	Digital Output 4
19	OUT6	Digital Output 6
20	IN0	Digital Input 0
21	IN2	Digital Input 2
22	-	Not connected
23	AIN10+	Analog input AIN10 non-inverted
24	AIN11+	Analog input AIN11 non-inverted
25	AIN14+	Analog input AIN14 non-inverted (Applicable only in configurations supporting 8 axes)
26	AIN15+	Analog input AIN15 non-inverted (Applicable only in configurations supporting 8 axes)
27	AOUT10+ (AOUT2+)	Analog output CS non-inverted

Pin #	Signal Designator	Description
28	AOUT11+ (AOUT6+)	Analog output CC non-inverted
29	AOUT14+	Analog output AOUT14 non-inverted (Applicable only in configurations supporting 8 axes)
30	AOUT15+	Analog output AOUT15 non-inverted (Applicable only in configurations supporting 8 axes)
31	V_SUP_IO	Input/Output Supply+
32	V_RTN_IO	Input/Output Supply Return
33	IN4/Z_MARK2	Digital Input 4 (can also be used for Z_MARK2)
34	IN5/T_MARK2	Digital Input 5 (can also be used for T_MARK2)
35	IN6/X_MARK2	Digital Input 6 (can also be used for X_MARK2)
36	IN7/Y_MARK2	Digital Input 7 (can also be used for Y_MARK2)

When employing IN4, IN5, IN6 and/or IN7 for MARK2, the normal delay for Digital Input (< 0.3 μSec) increases to 50 μSec.

37	AGND	Analog ground
38	AGND	Analog ground
39	-	Not connected
40	-	Not connected
41	-	Not connected

Pin #	Signal Designator	Description
42	-	Not connected
43	-	Not connected
44	-	Not connected

4.2.3.4 J20 - Safety & Fast I/O Inputs Connector

Label	J20 - SAFETY & FAST I/O
Connector Type	D-type 25-pin male
Mating Type	D-type 25-pin female (for easy prototyping a Phoenix FLKM HDSUB-25/M Sub-D to Screw Terminal converter can be used)

J20 serves for controlling Safety and Fast I/O input signals. The pinout for J20 is given in the following table:

Table 4-30. J20 - Safety and Fast I/O Inputs Pinout

Pin	Signal Designator	Description
1	V_SUP_SFTY	Safety Supply +
2	Z_MARK1+	Non-inverted MARK1 for Z axis
3	X_LL	X(0) Left Limit
4	A_LL	A(2) Left Limit
5	Y_LL	Y(1) Left Limit
6	B_LL	B(3) Left Limit
7	DGND	Digital ground
8	Y_MARK1+	Non-inverted MARK1 for Y(1) axis
9	X_MARK1+	Non-inverted MARK1 for X(0) axis
10	Y_PEG+	Non-inverted PEG for Y(1) axis
11	X_PEG+	Non-inverted PEG for X(0) axis
12	Z_PEG+	Non-inverted PEG for Z(4) axis

Pin	Signal Designator	Description
13	Z_PEG-	Inverted PEG for Z(4) axis
14	V_RTN_SFTY	Safety Supply Return
15	Z_MARK1-	Inverted MARK1 for Z(4) axis
16	X_RL	X(0) Right Limit
17	A_RL	A(2) Right Limit
18	Y_RL	Y(1) Right Limit
19	B_RL	B(3) Right Limit
20	Y_MARK1-	Inverted MARK1 for Y(1) axis
21	X_MARK1-	Inverted MARK1 for X(0) axis
22	Y_PEG-	Inverted PEG for Y(1) axis
23	X_PEG-	Inverted PEG for X(0) axis
24	ES+	Non-inverted Emergency Stop
25	ES-	Inverted Emergency Stop

4.2.3.5 J1, J3, J21, J22 - Drive Motor Connectors

Label	J1 B(3) MOTOR
	J3 Y(1) MOTOR
	J21 C(6) MOTOR
	J22 Z(4) MOTOR
Connector Type	MCV 1,5/4-GF-3,81
Mating Type	MC 1,5/4-STF-3,81

They serve for connecting the B(3) axis drive motor, Y(1) axis drive motor, C(6) axis drive motor, and the Z(4) axis drive motor, respectively, to the controller. The pinout of the connectors is given in the following table:

The dollar sign ($) stands for the given axis, for example, $_R can be B_R, Z_R, etc.

Table 4-31. J1, J3, J21and J22 - Drive Motor Pinout

Pin #	Signal Designator	Description
1	$_R	Motor R phase
2	$_S	Motor S phase
3	$_T	Motor T phase
4	EGND	Shield

4.2.3.6 J2 and J4 - Drive Motor Connectors

Label	J2_A(2) MOTOR J4_X(0) MOTOR
Connector Type	Phoenix PCV 4/4-G-7,62-BK
Mating Type	Phoenix PC 4/4-STF-7,62

They serve for connecting the A(2) axis drive motor and the X(0) axis drive motor, respectively, to the controller. The pinout of the connector is given in the following table:

Table 4-32. J2 and J4 - Drive Motor Pinout

Pin #	Signal Designator	Description
1	EGND	Shield
2	$_R	Motor R phase
3	$_S	Motor S phase
4	$_T	Motor T phase

The following diagrams illustrate how motors are to be connected

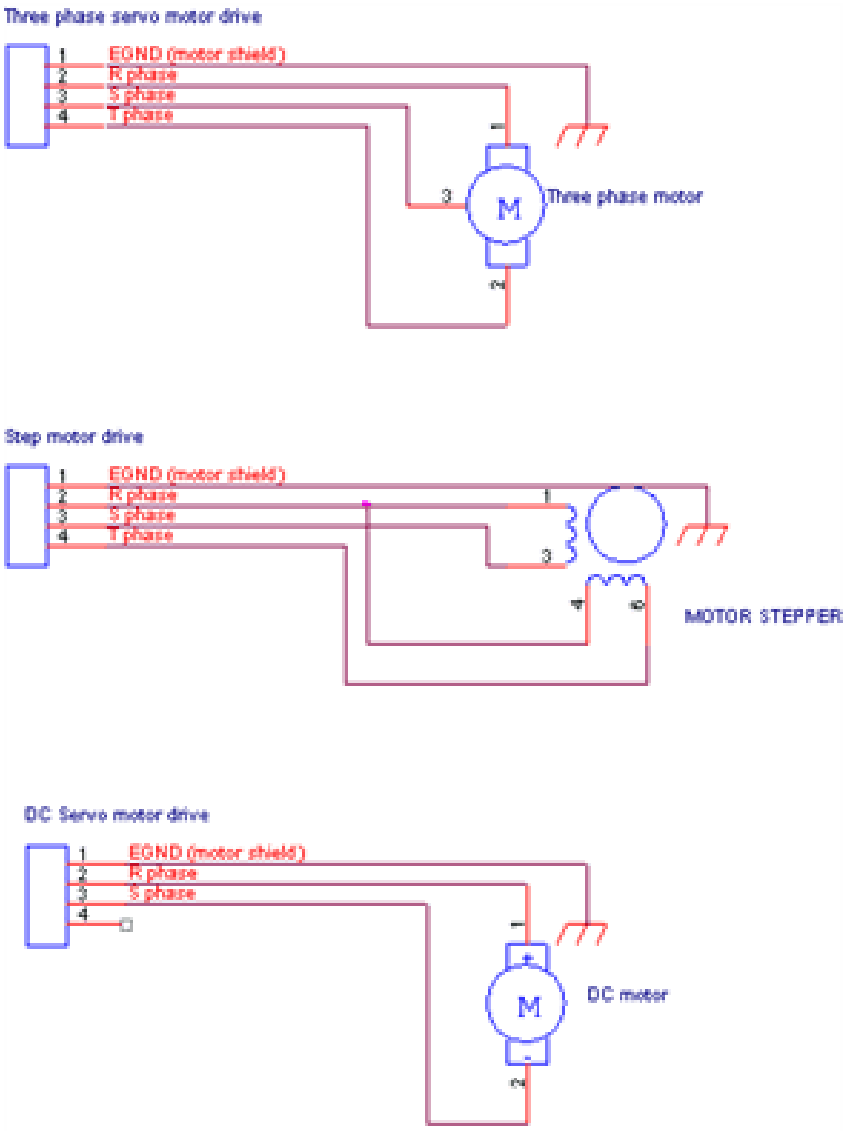


Figure 4-9. MB5U-ZV Motor Drive Connections

4.2.3.7 J8, J9 and J30 - HSSI Connectors

Label	J8 - HSSI0 J9 - HSSI1 J30 - HSSI2
Connector Type	RJ45 8-pin sockets
Mating Type	RJ45 8-pin plug

The pinout of the sockets is given in the following table:

Table 4-33. J8, J9 and J30 - HSSI Pinout

Pin #	Signal Designator	Description
1	CONTROL_$+	Control signal non-inverted output for channel 0
2	CONTROL_$-	Control signal inverted output for channel 0
3	SER_DI_$+	Serial data non-inverted input for channel 0
4	SER_DI_$-	Serial data inverted input for channel 0
5	SER_DO_$+	Serial data non-inverted output for channel 0
6	SER_DO_$-	Serial data inverted output for channel 0
7	DGND	Digital ground for 5L
8	DGND	Digital ground for 5L

4.2.3.8 J6 and J7 - Ethernet Connectors

Label	J6 - ETH1 J7 - ETH2
Connector Type	RJ45 8-pin socket
Mating Type	RJ45 8-pin plug

The J6/J7 pinout is given in the following table:

Table 4-34. J6 and J7 - Ethernet Pinout

Pin #	Signal Designator	Description
1	ETH$_TX+	Positive transmit signal
2	ETH$_TX -	Negative transmit signal
3	ETH$_RX +	Positive receive signal
4	-	Not connected
5	-	Not connected
6	ETH$_RX -	Negative receive signal
7	-	Not connected
8	-	Not connected

4.2.3.9 J19 - RS-232 Serial Communication Connector

Label	J19 - COM1
Connector Type	D-type 9-pin male
Mating type	D-type 9-pin female

The MC4U 9" and 11" do not have a COM2 port. Field recovery is not possible; to recover the controller firmware contact ACS.

The pinout of J19 is given in the following table:

Table 4-35. J19 - RS-232 Communication Pinout

Pin #	Signal Designator	Description
1	SHIELD	Cable shield connection
2	RX232	RS-232 receive signal for the serial communication port (COM1)
3	TX232	RS-232 transmit signal for serial communication port (COM1).
4	-	Not connected
5	DGND	Digital ground.
6	-	Not connected
7	-	Not connected
8	-	Not connected
9	-	Not connected

4.2.3.10 J23 - Z & C Safety Connector

Label	J23 - Z&C SAFETY
Connector Type	D-type 9-pin female
Mating Type	D-type 9-pin male

The pinout of the connector is given in the following table:

Table 4-36. J23 Pinout

Pin #	Signal Designator	Description
1	V_SUP_SFTY	Supply for limits input
2	Z_RL	Z(4) right limit
3	C_RL	C(6) right limit
4	-	Not connected
5	-	Not connected
6	V_RTN_SFTY	A return for limits input
7	Z_LL	Z(4) left limit
8	C_LL	C(6) left limit
9	-	Not connected

4.2.3.11 J11 - External Regeneration

Label	J11 - EXTERNAL REGENERATION
Connector Type	Phoenix PCV 5/2-GF-7,62
Mating Type	Phoenix PC 5/2-STF-7,62

The pinout of the connector is given in the following table:

Table 4-37. J11 Pinout

Pin #	Signal Designator	Description
1	REG1_1	Regeneration resistor for PS 1
2	REG1_2	Regeneration resistor for PS 1

4.2.3.12 J12 - Drive Supply Input

Label	J12 - DRIVE SUPPLY INPUT
Connector Type	Phoenix PCV 5/5-GF-7,62
Mating Type	Phoenix PC 5/5-STF-7,62

The pinout of the connector is given in the following table:

Table 4-38. J12 Pinout

Pin #	Signal Designator	Description
1	L1	AC input - phase L1
2	L2	AC input - phase L2
3	L3	AC input - phase L3
4	-	
5	EGND	Earth ground (shield)

4.2.3.13 J5 - 24V Logic Supply

Label	J5 - 24V LOGIC SUPPLY
Connector Type	Phoenix MCV 1.5/5 GF-3.81
Mating Type	Phoenix MCV 1.5/5 STF-3.81

The pinout of the connector is given in the following table:

Table 4-39. J5 Pinout

Pin #	Signal Designator	Description
1	24V_SUP	24V logic supply
2	24V_RTN	24V logic supply return
3	5V_ENC_EXT	External 5V supply for encoder
4	5V_ENC_EXT_RTN	External 5V supply return for encoder
5	EGND	Earth ground (shield)

4.2.3.14 MB5U-ZV Jumpers

This section details the settings of the MB5U-ZV jumpers.

> Only a qualified technician should make any changes to the factory settings of the jumpers. Remove the back cover of the unit to access the jumpers.

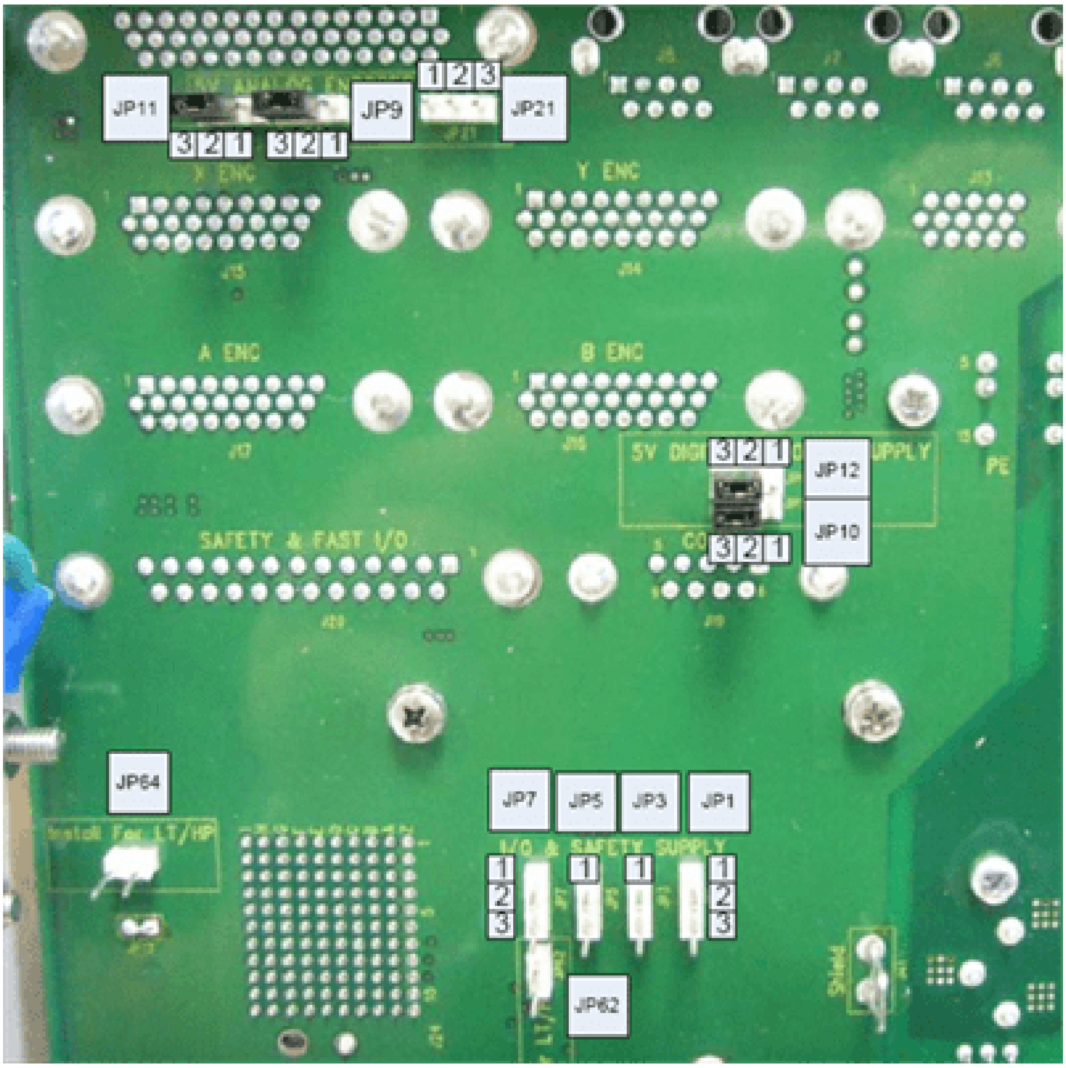


Figure 4-10. MB5U-ZV Jumpers

Table 4-40. Safety and I/O Supply Configuration

Name	Description	Functionality	Use for
JP1	5/24Vdc internal Safety supply	1-2 5Vdc internal 2-3 24Vdc internal	Safety supply configuration
JP3	5/24Vdc internal I/O supply	1-2 5Vdc internal 2-3 24Vdc internal	IO supply configuration
JP5	24_RTN/ DGND IO supply return	1-2 DGND 2-3 24V_RTN	IO supply configuration
JP7	24_RTN/ DGND safety supply return	1-2 DGND 2-3 24V_RTN	Safety supply configuration

Name	Description	Functionality	Use for
JP9	Internal or external analog encoder supply	1-2 External 2-3 Internal	Encoder supply
JP10	Internal or external digital encoder supply	1-2 External 2-3 Internal	Encoder supply
JP11	Internal or external analog encoder supply return	1-2 External 2-3 Internal (AGND)	Encoder supply
JP21	Encoder external supply return common ground	1-2 encoder external supply connect to AGND 2-3 encoder external supply connect to DGND	Encoder supply
JP12	Internal or external digital encoder supply return	1-2 External 2-3 Internal (DGND)	Encoder supply

If DDM3U-4-60V is installed in Slot 2, Jumper J50 has to be installed. For DDM3U-4-320V-xx it must be removed.

Table 4-41. I/O Jumpers

Setup	JP1	JP3	JP5	JP7
I/O supply external	N/A	Remove	Remove	N/A
I/O supply internal 5V	N/A	1-2	1-2	N/A
I/O supply internal 24V	N/A	2-3	2-3	N/A
Safety supply external	Remove	N/A	N/A	Remove
Safety supply internal 5V	1-2	N/A	N/A	1-2
Safety supply internal 24V	2-3	N/A	N/A	2-3

If an internal power supply is used for safety or I/O, do not connect an external power supply to the V_SUP_SFTY/V_RTN_SFTY of the Encoder connectors or the OUT of the Digital Output connectors.

When using the 5V internal supply for digital I/O or Safety, these I/Os are not isolated.

Table 4-42. Encoder Supply

Setup	JP9	JP10	JP11	JP12	JP21
Analog encoder external supply	1-2	N/A	1-2	N/A	1-2
Analog encoder internal supply	2-3	N/A	2-3	N/A	Open
Digital encoder external supply	N/A	1-2	N/A	1-2	2-3
Digital encoder internal supply	N/A	2-3	N/A	2-3	Open

Table 4-43. Default Jumper Settings

Jumper	Setting
JP1	Open
JP3	Open
JP5	Open
JP7	Open
JP9	2-3
JP10	2-3
JP11	2-3
JP12	2-3
JP21	2-3

4.2.4 MB5U-ZZZ

The MB5U-ZZZ is installed in the MC4U-19-Piano-enc.

The connectors associated with the MB5U-ZZZ are shown in the following figure:

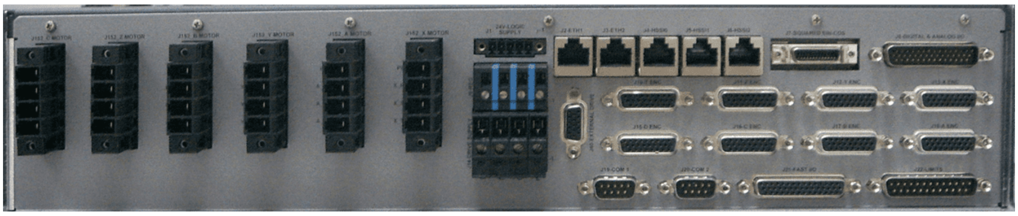


Figure 4-11. MB5U-ZZZ Connectors

4.2.4.1 MB5U-ZZZ Functionality

The MB5U-ZZZ accommodates any SPiiPlus Motion Controller, three DDM3U-2-320V-XX (up to 24A) drives and one PSM3U-320V-8KW power supply. It supports the following functionality:

- 8 x Digital encoders
- 8 x SIN-COS encoders (optional)
- 8 x Hall effect sensors
- 8 x Motor Temperature sensors
- 16 x Safety inputs
- 1 x E-stop
- 8 x Digital outputs/Mechanical brakes
- 8 x Digital inputs
- 4 x Analog I/O
- 5 x MARK signals
- 1 x Squared SIN-COS signals for axes 0(X), 2(A), 1(Y), 3(B)
- 4 x PEG signals, plus 3 x STATE signals
- 6 x Motor output signals
- 2 x Ethernet channels
- 3 x HSSI channels
- 2 x RS-232 channels
- 2 x External Drive controls (T, D)

4.2.4.2 Encoder and Hall Connectors

Label	J10-T(5) ENC
	J11-Z(4) ENC
	J12-Y(1) ENC
	J13-X(0) ENC
	J15-D(7) ENC
	J16-C(6) ENC
	J17-B(3) ENC
	J18-A(2) ENC
Connector Type	D-type 26-pin HD female
Mating Type	D-type 26-pin HD male (for easy prototyping a Phoenix FLKM HDSUB-26/M Sub-D to Screw Terminal converter can be used)

The connectors are allocated as follows:

Connector	Axis	Connector	Axis
J10 - T ENC	T(5)	J15 - D ENC	D(7)
J11 - Z ENC	Z(4)	J16 - C ENC	C(6)
J12 - Y ENC	Y(1)	J17 - B ENC	B(3)
J13 - X ENC	X(0)	J18 - A ENC	A(2)

The pinout for the Encoder/Hall Connectors is given in the following table:

> The dollar sign ($) stands for the given axis, for example, $_LL can be X_LL, or Y_LL, etc.

Table 4-44. Encoder/Hall Pinout

Pin	Signal Designator	Description
1	$_CHA-	Encoder A(2) inverted input
2	$_CHB-	Encoder B(3) inverted input
3	$_CHI-	Encoder index inverted input
4	$_HB	Motor Hall B
5	V_SUP_SFTY	Supply for the limits input
6	$_RL	Right limit
7	$_SIN-	Encoder SIN inverted input
8	$_COS-	Encoder COS inverted input
9	$_SC_I-	Encoder SIN-COS Index inverted input
10	$_CHA+	Encoder A(2) non-inverted input
11	$_CHB+	Encoder B(3) non-inverted input
12	$_CHI+	Encoder Index non-inverted input
13	$_HA	Motor Hall A
14	$_HC	Motor Hall C
15	$_LL	Left limit
16	$_SIN+	SIN non-inverted input
17	$_COS+	Encoder COS non-inverted input
18	$_SC_I+	Encoder SIN-COS Index non-inverted input
19	5U	5V user supply for the digital encoder and Hall
20	5U_RTN	5V return user supply for the digital encoder and Hall
21	Shield	Shield
22	$_MTMP	Motor temperature sensor input
23	V_RTN_IO	A return for the Motor temperature sensor

Pin	Signal Designator	Description
24	V_RTN_SFTY	A return for the limits input
25	5F	5V user supply for the analog encoder and Hall
26	5F_RTN	5V return user supply for the analog encoder and Hall

4.2.4.3 J7 - Squared SIN-COS Connector

Label	J7 - SQUARED SIN-COS
Connector Type	3M, 10226-6212PC Mini D Ribbon (MDR), 26-pin female
Mating Type	3M, 10126-3000-PE Mini D Ribbon (MDR), 26-pin male

The pinout for J7 is given in the following table:

Table 4-45. J7 - Squared Sin-Cos Pinout

Pin #	Signal Designator	Description
1	X_CHA+	X(0) Channel A(2) non-inverted digital encoder output
2	X_CHA-	X(0) Channel A(2) inverted digital encoder output
3	X_CHB+	X(0) Channel B(3) non-inverted digital encoder output
4	X_CHB-	X(0) Channel B(3) inverted digital encoder output
5	X_CHI+	Not Used
6	X_CHI-	Not Used
7	A_CHA+	Not Used
8	A_CHA-	Not Used
9	A_CHB+	Not Used
10	A_CHB-	Not Used
11	A_CHI+	Not Used
12	A_CHI-	Not Used
13	DGND	Internal digital supply return
14	Y_CHA+	Y(1) Channel A(2) non-inverted digital encoder output

Pin #	Signal Designator	Description
15	Y_CHA-	Y(1) Channel A(2) inverted digital encoder output
16	Y_CHB+	Y(1) Channel B(3) non-inverted digital encoder output
17	Y_CHB-	Y(1) Channel B(3) inverted digital encoder output
18	Y_CHI+	Not Used
19	Y_CHI-	Not Used
20	B_CHA-	Not Used
21	B_CHB+	Not Used
22	B_CHB-	Not Used
23	B_CHI+	Not Used
24	B_CHI-	Not Used
25	B_CHA-	Not Used
26	-	Not connected

4.2.4.4 J8 - Digital and Analog I/O Connector

Label	J8 - DIGITAL & ANALOG I/O
Connector Type	D-type 44-pin HD male
Mating Type	D-type 44-pin HD female (for easy prototyping a Phoenix FLKM HDSUB-44/M Sub-D to Screw Terminal converter can be used)

J8 serves for controlling Digital and Analog I/O signal formats.

The pinout for J8 is given in the following table:

Table 4-46. J8 - Digital and Analog I/O Pinout

Pin #	Signal Designator	Description
1	OUT1	Digital Output 1
2	OUT3	Digital Output 3
3	OUT5	Digital Output 5

Pin #	Signal Designator	Description
4	OUT7	Digital Output 7
5	IN1	Digital Input 1
6	IN3	Digital Input 3
7	AGND	Analog ground
8	AIN10-	Analog input AIN10 inverted
9	AIN11-	Analog input AIN11 inverted
10	AIN14-	Analog input AIN14 inverted
11	AIN15-	Analog input AIN15 inverted
12	AOUT10-	Analog output AOUT10 inverted
13	AOUT11-	Analog output AOUT11 inverted
14	AOUT14-	Analog output AOUT14 inverted
15	AOUT15-	Analog output AOUT15 inverted
16	OUT0	Digital Output 0
17	OUT2	Digital Output 2
18	OUT4	Digital Output 4
19	OUT6	Digital Output 6
20	IN0	Digital Input 0
21	IN2	Digital Input 2
22	-	Not connected
23	AIN10+	Analog input AIN10 non-inverted
24	AIN11+	Analog input AIN11 non-inverted
25	AIN14+	Analog input AIN14 non-inverted
26	AIN15+	Analog input AIN15 non-inverted

Pin #	Signal Designator	Description
27	AOUT10+ (AOUT2+)	Analog output AOUT10 non-inverted
28	AOUT11+ (AOUT6+)	Analog output AOUT11 non-inverted
29	AOUT14+ (AOUT10+)	Analog output AOUT14 non-inverted
30	AOUT15+ (AOUT14+)	Analog output AOUT15 non-inverted
31	V_SUP_IO	Input/Output Supply+
32	V_RTN_IO	Input/Output Supply Return
33	IN4/Z_MARK2	Digital Input 4 (can also be used for Z_MARK2)
34	IN5/T_MARK2	Digital Input 5 (can also be used for T_MARK2)
35	IN6/X_MARK2	Digital Input 6 (can also be used for X_MARK2)
36	IN7/Y_MARK2	Digital Input 7 (can also be used for Y_MARK2)
When employing IN4, IN5, IN6 and/or IN7 for MARK2, the normal delay for Digital Input (< 0.3 μSec) increases to 50 μSec.		
37	AGND	Analog ground
38	AGND	Analog ground
39	-	Not connected
40	-	Not connected
41	-	Not connected

Pin #	Signal Designator	Description
42	+12V1	12V for joystick (optional, required special P/N)
43	12V1_RTN	+-12V return for joystick (optional, required special P/N)
44	-12V1	-12V for joystick joystick (optional, required special P/N)

4.2.4.5 J9 - Regeneration Connector

J9 is relevant only if the PSM3U-320V-XXkW (high-power supply) is being used.

Label	J9 - REGENERATION
Connector Type	Phoenix FRONT 2,5-V/SA 10
Mating Type	None (screw terminal)

The pinout for J9 is provided in the following table:

Table 4-47. J9 - Regeneration Pinout

Pin #	Signal Designator	Description
1	REG1_1	Regeneration resistor for PS 1 (V1 on the motherboard)
2	REG1_2	Regeneration resistor for PS 1
3	REG2_1	Regeneration resistor for PS 2 (V2 on the motherboard)
4	REG2_2	Regeneration resistor for PS 2

4.2.4.6 J21 - Fast I/O (PEG & Mark) Connector

Label	J21 - FAST I/O
Connector Type	D-type 44-pin HD female
Mating Type	D-type 44-pin HD male (for easy prototyping a Phoenix FLKM HDSUB-44/M Sub-D to Screw Terminal converter can be used)

The pinout for J21 is provided in the following table:

Table 4-48. J21 - Fast I/O Pinout

Pin #	Signal Designator	Description
1	-	Not connected.
2	-	Not connected
3	-	Not connected
4	X_STATE2+	State Digital output non-inverted
5	X_STATE1+	State Digital output non-inverted
6	X_STATE0+	State Digital output non-inverted
7	-	Not connected
8	-	Not connected
9	DGND	Internal digital supply return
10	DGND	Internal digital supply return
11	T_PEG+	PEG Digital output non-inverted
12	Z_PEG+	PEG Digital output non-inverted
13	Y_PEG+	PEG Digital output non-inverted
14	X_PEG+	PEG Digital output non-inverted
15	-	Not connected.
16	-	Not connected
17	-	Not connected
18	-	Not connected
19	X_STATE2-	State Digital output inverted
20	X_STATE1-	State Digital output inverted
21	X_STATE0-	State Digital output inverted
22	-	Not connected
23	-	Not connected

Pin #	Signal Designator	Description
24	-	Not connected
25	-	Not connected
26	T_PEG-	PEG Digital output inverted
27	Z_PEG-	PEG Digital output inverted
28	Y_PEG-	PEG Digital output inverted
29	X_PEG-	PEG Digital output inverted
30	-	Not connected
31	X_MARK1+	Mark Digital input non-inverted
32	X_MARK1-	Mark Digital input inverted
33	-	Not connected
34	-	Not connected
35	Y_MARK1+	Mark Digital input non-inverted
36	Y_MARK1-	Mark Digital input inverted
37	-	Not connected.
38	-	Not connected
39	Z_MARK1+	Mark Digital input non-inverted
40	Z_MARK1-	Mark Digital input inverted
41	-	Not connected
42	-	Not connected
43	T_MARK1+	Mark Digital input non-inverted
44	T_MARK1-	Mark Digital input inverted

4.2.4.7 J22 - Motor Limits Connector

Label	J22 - LIMITS
Connector Type	D-type 25-pin male
Mating Type	D-type 25-pin female (for easy prototyping a Phoenix FLKM HDSUB-25/M Sub-D to Screw Terminal converter can be used)

The pinout for J22 is given in the following table:

Table 4-49. J22 - Motor Limits Pinout

Pin #	Signal Designator	Description
1	V_SUP_SFTY	Safety Supply +
2	-	Not connected
3	X_LL	X(0) Left Limit
4	A_LL	A(2) Left Limit
5	Y_LL	Y(1) Left Limit
6	B_LL	B(3) Left Limit
7	Z_LL	Z(4) Left Limit
8	C_LL	C(6) Left Limit
9	T_LL	T(5) Left Limit
10	D_LL	D(7) Left Limit
11	-	Not connected
12	-	Not connected
13	-	Not connected
14	V_RTN_SFTY	Safety Supply Return
15	-	Not connected
16	X_RL	X(0) Right Limit
17	A_RL	A(2) Right Limit

Pin #	Signal Designator	Description
18	Y_RL	Y(1) Right Limit
19	B_RL	B(3) Right Limit
20	Z_RL	Z(4) Right Limit
21	C_RL	C(6) Right Limit
22	T_RL	T(5) Right Limit
23	D_RL	D(7) Right Limit
24	ES+	Emergency stop non-inverted
25	ES-	Emergency stop inverted

4.2.4.8 J4, J5, and J6 - HSSI Connectors

Label	J4 - HSSI0 (X & A axes)
	J5 - HSSI1 (Y & B axes)
	J6 - HSSI2 (Z & C axes)
Connector Type	RJ45 8-pin sockets
Mating Type	RJ45 8-pin plug

The pinout of the sockets is given in the following table:

Table 4-50. J4, J5, and J6 - HSSI Pinout

Pin #	Signal Designator	Description
1	CONTROL_$+	Control signal non-inverted output for channel 0
2	CONTROL_$-	Control signal inverted output for channel 0
3	SER_DI_$+	Serial data non-inverted input for channel 0
4	SER_DI_$-	Serial data inverted input for channel 0
5	SER_DO_$+	Serial data non-inverted output for channel 0
6	SER_DO_$-	Serial data inverted output for channel 0
7	DGND	Digital ground for 5L

Pin #	Signal Designator	Description
8	DGND	Digital ground for 5L

4.2.4.9 J2 and J3 - Ethernet Connectors

Label	J2 - ETH1 J3 - ETH2
Connector Type	RJ45 8-pin socket
Mating Type	RJ45 8-pin plug

The pinout of the sockets is given in the following table:

Table 4-51. J2 and J3 - Ethernet Pinout

Pin #	Signal Designator	Description
1	ETH$_TX+	Positive transmit signal
2	ETH$_TX -	Negative transmit signal
3	ETH$_RX +	Positive receive signal
4	-	Not connected
5	-	Not connected
6	ETH$_RX -	Negative receive signal
7	-	Not connected
8	-	Not connected

4.2.4.10 J19 and J20 RS-232 Communication Connectors

Label	J19 - COM1 J20 - COM2
Connector Type	D-type 9-pin male sockets
Mating type	D-type 9-pin female

When necessary, use COM2 to run the MMI Application Studio Upgrade and Recovery Wizard Recovery Task (see the MMI Application Studio User Guide for details).

The pinout for the connectors is given in the following table:

Table 4-52. J19 and J20 - RS-232 Communication Pinout

Pin #	Signal Designator	Description
1	SHIELD	Cable shield connection
2	RX232	RS-232 receive signal for the communication port (J19 for COM1, and J20 for COM2)
3	TX232	RS-232 transmit signal for communication port (J19 for COM1, and J20 for COM2).
4	-	Not connected
5	DGND	Digital ground.
6	-	Not connected
7	-	Not connected
8	-	Not connected
9	-	Not connected

4.2.4.11 J14 - Drive Supply Voltage Connector

Label	J14 - DRIVE SUPPLY
Connector Type	Phoenix FRONT 4V-7,62
Mating Type	None (screw terminal)

AC power is provided through J14.

The pinout for the connector is provided in the following table:

Table 4-53. J14 - Drive Supply Voltage Pinout

Pin #	Signal Designator	Description	Remarks
1	EGND	Earth Ground (shield)	
2	L3	AC input phase L3	
3	L2	AC input phase L2	When using AC single-phase, the voltage has to be connected between L1 and L2.
4	L1	AC input phase L1	

4.2.4.12 J1 - 24V Logic Supply Connector

Label	J1 - 24V LOGIC SUPPLY
Connector Type	Phoenix MCV-1.5/5 GF 3.81
Mating Type	Phoenix MC-1.5/5 STF- 3.81

24Vdc is provided through J1.

The J1 pinout is provided in the following table:

Table 4-54. J1 - 24V Logic Supply Pinout

Pin #	Signal Designator	Description
1	24V_SUP	24V logic supply
2	24V_RTN	24V logic supply return
3	5V_ENC_EXT	External 5V supply for encoder
4	5V_ENC_EXT_RTN	External 5V supply return for encoder
5	EGND	Electrical Ground

4.2.4.13 J40 - External Drive Control Signals

Label	J40 - EXTERNAL DRIVE
Connector Type	D-type HD 15-pin female
Mating Type	D-type HD 15-pin male

J40 serves for supplying control signals to external drives.

The J40 pinout is given in the following table:

Table 4-55. J40 - External Drive Control Signals Pinout

Pin #	Signal Designator	Description
1	T_CMD0+	T(5) Drive Command 0+
2	T_CMD0-	T(5) Drive Command 0-
3	T_CMD1+	T(5) Drive Command 1+
4	T_CMD1-	T(5) Drive Command 1-
5	T_ENA	T(5) axis enable signal
6	D_CMD0+	D(7) Drive Command 0+
7	D_CMD0-	D(7) Drive Command 0-
8	D_CMD1+	D(7) Drive Command 1+
9	D_CMD1-	D(7) Drive Command 1-
10	T_FLT	T(5) axis fault signal
11	AGND	Analog ground
12	DGND	Digital ground
13	5U	5V user supply for digital encoder and Hall sensor
14	D_ENA	D(7) axis enable signal
15	D_FLT	D(7) axis fault signal

4.2.4.14 J152_$ - Motor Drive Output

Label	J152_X(0)
	J152_Y(1)
	J152_Z(4)
	J152_A(2)
	J152_B(3)
	J152_C(6)
Connector Type	Phoenix PCV 4/4-G-7,62-BK
Mating Type	Phoenix PC 4/ 4-STF-7,62

The connectors are allocated as follows:

Connector	Axis	Connector	Axis
J152_X	X(0)	J152_A	A(2)
J152_Y	Y(1)	J152_B	B(3)
J152_Z	Z(4)	J152_C	C(6)

The J152_$ pinout is given in the following table:

Table 4-56. J152_$ - Motor Drive Pinout

Pin #	Signal Designator	Description
1	EGND	Shield
2	$_R	Motor $ R phase
3	$_S	Motor $ S phase
4	$_T	Motor $ T phase

The following diagrams illustrate how motors are to be connected.

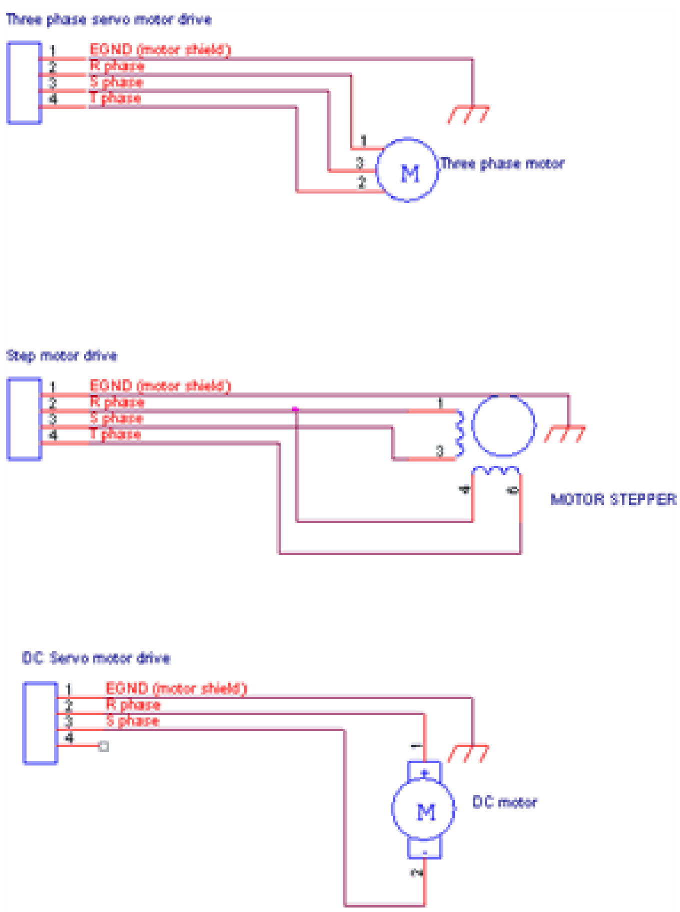


Figure 4-12. MB5U-ZZZ Motor Drive Connections

4.2.4.15 MB5U-ZZZ Jumpers

Only a qualified technician should make any changes to the factory settings of the jumpers. Remove the back cover of the unit to access the jumpers.

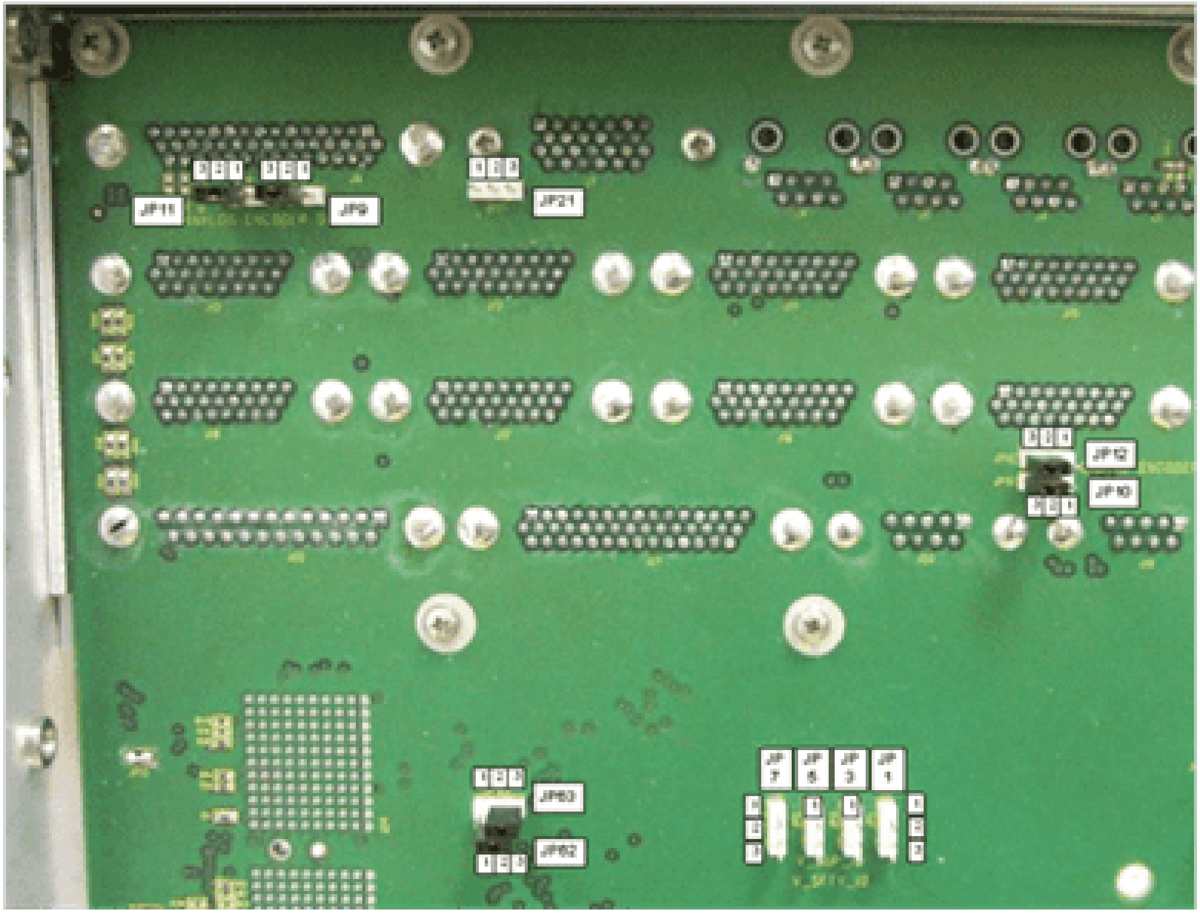


Figure 4-13. MB5U-ZZZ Jumpers and Pin Numbers

The following table provides details of the settings of the MB5U-ZZZ jumpers.

Table 4-57. MB5U-ZZZ Jumpers

Name	Description	Functionality	Use for
JP1	5/24Vdc internal Safety supply	1-2 5Vdc internal 2-3 24Vdc internal	Safety supply configuration
JP3	5/24Vdc internal I/O supply	1-2 5Vdc internal 2-3 24Vdc internal	IO supply configuration
JP5	24_RTN/ DGND IO supply return	1-2 DGND 2-3 24V_RTN	IO supply configuration
JP7	24_RTN/ DGND safety supply return	1-2 DGND 2-3 24V_RTN	Safety supply configuration

Name	Description	Functionality	Use for
JP9	Internal or external analog encoder supply	1-2 External 2-3 Internal	Encoder supply
JP10	Internal or external digital encoder supply	1-2 External 2-3 Internal	Encoder supply
JP11	Internal or external analog encoder supply return	1-2 External 2-3 Internal (AGND)	Encoder supply
JP21	Encoder external supply return common ground	1-2 encoder external supply connect to AGND 2-3 encoder external supply connect to DGND	Encoder supply
JP12	Internal or external digital encoder supply return	1-2 External 2-3 Internal (DGND)	Encoder supply
JP13	Digital ground to shield connection	Install – galvanic connection between digital ground to shield	Internal use only
JP14	Digital ground to analog ground connection	Install – galvanic connection between digital ground to analog ground	Internal use only

If an internal power supply is used for safety or I/O, do not connect an external power supply to the V_SUP_SFTY/V_RTN_SFTY of the Encoder connectors or the OUT of the Digital Output connectors.

Table 4-58. Default Jumper Settings

Jumper	Setting
JP1	Open
JP3	Open
JP5	Open
JP7	Open

Jumper	Setting
JP9	2-3
JP10	2-3
JP11	2-3
JP12	2-3
JP21	2-3

4.2.5 MB5U-ZZW

The MB5U-ZZW is installed in the MC4U-19-Piano-enc.

The connectors associated with the MB5U-ZZW are shown in the following figure:

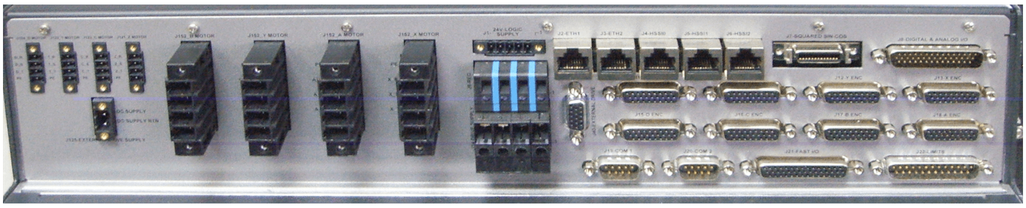


Figure 4-14. MB5U-ZZW Connectors

4.2.5.1 MB5U-ZZW Functionality

The MB5U-ZZW accommodates any SPiiPlus Motion Controller, two DDM3U-2-320V-XX (up to 10A/20A) drives, one DDM3U-4-60V-XX dive, and PSM3U-320V-8KW and PSM3U-48V-0.7KW power supplies. It supports the following functionality:

- 8 x Digital encoders
- 8 x SIN-COS encoders (optional)
- 8 x Hall effect sensors
- 8 x Motor Temperature sensors
- 16 x Safety inputs
- 1 x E-stop
- 8 x Digital outputs/Mechanical brakes
- 8 x Digital inputs
- 4 x Analog I/O
- 5 x MARK signals
- 1 x Squared SIN-COS signals for axes 0(X), 2(A), 1(Y), 3(B)
- 4 x PEG signals, plus 3 x STATE signals
- 8 x Motor output signals
- 2 x Ethernet channels

> 2 x HSSI channels
> 2 x RS-232 channels
> 2 x External Drive controls (T, D)

4.2.5.2 Encoder and Hall Connectors

Label	J10-T(5) ENC
	J11-Z(4) ENC
	J12-Y(1) ENC
	J13-X(0) ENC
	J15-D(7) ENC
	J16-C(6) ENC
	J17-B(3) ENC
	J18-A(2) ENC
Connector Type	D-type 26-pin HD female
Mating Type	D-type 26-pin HD male (for easy prototyping a Phoenix FLKM HDSUB-26/M Sub-D to Screw Terminal converter can be used)

The connectors are allocated as follows:

Connector	Axis	Connector	Axis
J10 - T ENC	T(5)	J15 - D ENC	D(7)
J11 - Z ENC	Z(4)	J16 - C ENC	C(6)
J12 - Y ENC	Y(1)	J17 - B ENC	B(3)
J13 - X ENC	X(0)	J18 - A ENC	A(2)

The pinout for the Encoder/Hall Connectors is given in the following table:

The dollar sign ($) stands for the given axis, for example, $_LL can be X_LL, Y_LL, etc.

Table 4-59. Encoder/Hall Pinout

Pin	Signal Designator	Description
1	$_CHA-	Encoder A(2) inverted input
2	$_CHB-	Encoder B(3) inverted input
3	$_CHI-	Encoder index inverted input
4	$_HB	Motor Hall B
5	V_SUP_SFTY	Supply for the limits input
6	$_RL	Right limit
7	$_SIN-	Encoder SIN inverted input
8	$_COS-	Encoder COS inverted input
9	$_SC_I-	Encoder SIN-COS Index inverted input
10	$_CHA+	Encoder A(2) non-inverted input
11	$_CHB+	Encoder B(3) non-inverted input
12	$_CHI+	Encoder Index non-inverted input
13	$_HA	Motor Hall A
14	$_HC	Motor Hall C
15	$_LL	Left limit
16	$_SIN+	SIN non-inverted input
17	$_COS+	Encoder COS non-inverted input
18	$_SC_I+	Encoder SIN-COS Index non-inverted input
19	5U	5V user supply for the digital encoder and Hall
20	5U_RTN	5V return user supply for the digital encoder and Hall
21	Shield	Shield
22	$_MTMP	Motor temperature sensor input
23	V_RTN_IO	A return for the Motor temperature sensor

Pin	Signal Designator	Description
24	V_RTN_SFTY	A return for the limits input
25	5F	5V user supply for the analog encoder and Hall
26	5F_RTN	5V return user supply for the analog encoder and Hall

4.2.5.3 J7 - Squared SIN-COS Connector

Label	J7 - SQUARED SIN-COS
Connector Type	3M, 10226-6212PC Mini D Ribbon (MDR), 26-pin female
Mating Type	3M, 10126-3000-PE Mini D Ribbon (MDR), 26-pin male

The pinout for J7 is given in the following table:

Table 4-60. J7 - Squared Sin-Cos Pinout

Pin #	Signal Designator	Description
1	X_CHA+	X(0) Channel A(2) non-inverted digital encoder output
2	X_CHA-	X(0) Channel A(2) inverted digital encoder output
3	X_CHB+	X(0) Channel B(3) non-inverted digital encoder output
4	X_CHB-	X(0) Channel B(3) inverted digital encoder output
5	X_CHI+	Not Used
6	X_CHI-	Not Used
7	A_CHA+	Not Used
8	A_CHA-	Not Used
9	A_CHB+	Not Used
10	A_CHB-	Not Used
11	A_CHI+	Not Used
12	A_CHI-	Not Used
13	DGND	Internal digital supply return
14	Y_CHA+	Y(1) Channel A(2) non-inverted digital encoder output

Pin #	Signal Designator	Description
15	Y_CHA-	Y(1) Channel A(2) inverted digital encoder output
16	Y_CHB+	Y(1) Channel B(3) non-inverted digital encoder output
17	Y_CHB-	Y(1) Channel B(3) inverted digital encoder output
18	Y_CHI+	Not Used
19	Y_CHI-	Not Used
20	B_CHA-	Not Used
21	B_CHB+	Not Used
22	B_CHB-	Not Used
23	B_CHI+	Not Used
24	B_CHI-	Not Used
25	B_CHA-	Not Used
26	-	Not connected

4.2.5.4 J8 - Digital and Analog I/O Connector

Label	J8 - DIGITAL & ANALOG I/O
Connector Type	D-type 44-pin HD male
Mating Type	D-type 44 pin HD female (for easy prototyping a Phoenix FLKM HDSUB-44/M Sub-D to Screw Terminal converter can be used)

J8 serves for controlling Digital and Analog I/O signal formats. The pinout for J8 is given in the following table:

Table 4-61. J8 - Digital and Analog I/O Pinout

Pin #	Signal Designator	Description
1	OUT1	Digital Output 1
2	OUT3	Digital Output 3
3	OUT5	Digital Output 5

Pin #	Signal Designator	Description
4	OUT7	Digital Output 7
5	IN1	Digital Input 1
6	IN3	Digital Input 3
7	AGND	Analog ground
8	AIN10-	Analog input AIN10 inverted
9	AIN11-	Analog input AIN11 inverted
10	AIN14-	Analog input AIN14 inverted
11	AIN15-	Analog input AIN15 inverted
12	AOUT10-	Analog output AOUT10 inverted
13	AOUT11-	Analog output AOUT11 inverted
14	AOUT14-	Analog output AOUT14 inverted
15	AOUT15-	Analog output AOUT15 inverted
16	OUT0	Digital Output 0
17	OUT2	Digital Output 2
18	OUT4	Digital Output 4
19	OUT6	Digital Output 6
20	IN0	Digital Input 0
21	IN2	Digital Input 2
22	-	Not connected
23	AIN10+	Analog input AIN10 non-inverted
24	AIN11+	Analog input AIN11 non-inverted
25	AIN14+	Analog input AIN14 non-inverted
26	AIN15+	Analog input AIN15 non-inverted

Pin #	Signal Designator	Description
27	AOUT10+ (AOUT2+)	Analog output AOUT10 non-inverted
28	AOUT11+ (AOUT6+)	Analog output AOUT11 non-inverted
29	AOUT14+ (AOUT10+)	Analog output AOUT14 non-inverted
30	AOUT15+ (AOUT14+)	Analog output AOUT15 non-inverted
31	V_SUP_IO	Input/Output Supply+
32	V_RTN_IO	Input/Output Supply Return
33	IN4/Z_MARK2	Digital Input 4 (can also be used for Z_MARK2)
34	IN5/T_MARK2	Digital Input 5 (can also be used for T_MARK2)
35	IN6/X_MARK2	Digital Input 6 (can also be used for X_MARK2)
36	IN7/Y_MARK2	Digital Input 7 (can also be used for Y_MARK2)
When employing IN4, IN5, IN6 and/or IN7 for MARK2, the normal delay for Digital Input (< 0.3 μSec) increases to 50 μSec.		
37	AGND	Analog ground
38	AGND	Analog ground
39	-	Not connected
40	-	Not connected
41	-	Not connected

Pin #	Signal Designator	Description
42	+12V1	12V for joystick (optional, need 0Ω resistor) (Not Applicable)
43	12V1_RTN	+-12V return for joystick (optional, need 0Ω resistor) (Not Applicable)
44	-12V1	-12V for joystick (optional, need 0Ω resistor) (Not Applicable)

4.2.5.5 J9 - Regeneration Connector

J9 is relevant only if the PSM3U-320V-XXkW (high-power supply) is being used.

Label	J9 - REGENERATION
Connector Type	Phoenix FRONT 2,5-V/SA 10
Mating Type	None (screw terminal)

The pinout for J9 is provided in the following table:

Table 4-62. J9 - Regeneration Pinout

Pin #	Signal Designator	Description
1	REG1_1	Regeneration resistor for PS 1 (V1 on the motherboard)
2	REG1_2	Regeneration resistor for PS 1
3	REG2_1	Regeneration resistor for PS 2 (V2 on the motherboard)
4	REG2_2	Regeneration resistor for PS 2

4.2.5.6 J21 - Fast I/O (PEG & Mark) Connector

Label	J21 - FAST I/O
Connector Type	D-type 44-pin HD female connector.

Mating Type	D-type 44-pin HD male (for easy prototyping a Phoenix FLKM HDSUB-44/M Sub-D to Screw Terminal converter can be used)

The pinout for J21 is given in the following table:

Table 4-63. J21 - Fast I/O Pinout

Pin #	Signal Designator	Description
1	-	Not connected.
2	-	Not connected
3	-	Not connected
4	X_STATE2+	State Digital output non-inverted
5	X_STATE1+	State Digital output non-inverted
6	X_STATE0+	State Digital output non-inverted
7	-	Not connected
8	-	Not connected
9	DGND	Internal digital supply return
10	DGND	Internal digital supply return
11	T_PEG+	PEG Digital output non-inverted
12	Z_PEG+	PEG Digital output non-inverted
13	Y_PEG+	PEG Digital output non-inverted
14	X_PEG+	PEG Digital output non-inverted
15	-	Not connected.
16	-	Not connected
17	-	Not connected
18	-	Not connected
19	X_STATE2-	State Digital output inverted
20	X_STATE1-	State Digital output inverted

Pin #	Signal Designator	Description
21	X_STATE0-	State Digital output inverted
22	-	Not connected
23	-	Not connected
24	-	Not connected
25	-	Not connected
26	T_PEG-	PEG Digital output inverted
27	Z_PEG-	PEG Digital output inverted
28	Y_PEG-	PEG Digital output inverted
29	X_PEG-	PEG Digital output inverted
30	-	Not connected
31	X_MARK1+	Mark Digital input non-inverted
32	X_MARK1-	Mark Digital input inverted
33	-	Not connected
34	-	Not connected
35	Y_MARK1+	Mark Digital input non-inverted
36	Y_MARK1-	Mark Digital input inverted
37	-	Not connected
38	-	Not connected
39	Z_MARK1+	Mark Digital input non-inverted
40	Z_MARK1-	Mark Digital input inverted
41	-	Not connected
42	-	Not connected
43	T_MARK1+	Mark Digital input non-inverted
44	T_MARK1-	Mark Digital input inverted

4.2.5.7 J22 - Motor Limits Connector

Label	J22 - LIMITS
Connector Type	D-type 25-pin male
Mating Type	D-type 25-pin female (for easy prototyping a Phoenix FLKM HDSUB-25/M Sub-D to Screw Terminal converter can be used)

The pinout for J22 is given in the following table:

Pin #	Signal Designator	Description
1	V_SUP_SFTY	Safety Supply +
2	-	Not connected
3	X_LL	X(0) Left Limit
4	A_LL	A(2) Left Limit
5	Y_LL	Y(1) Left Limit
6	B_LL	B(3) Left Limit
7	Z_LL	Z(4) Left Limit
8	C_LL	C(6) Left Limit
9	T_LL	T(5) Left Limit
10	D_LL	D(7) Left Limit
11	-	Not connected
12	-	Not connected
13	-	Not connected
14	V_RTN_SFTY	Safety Supply Return
15	-	Not connected
16	X_RL	X(0) Right Limit
17	A_RL	A(2) Right Limit

Pin #	Signal Designator	Description
18	Y_RL	Y(1) Right Limit
19	B_RL	B(3) Right Limit
20	Z_RL	Z(4) Right Limit
21	C_RL	C(6) Right Limit
22	T_RL	T(6) Right Limit
23	D_RL	D(7) Right Limit
24	ES+	Emergency stop non-inverted
25	ES-	Emergency stop inverted

4.2.5.8 J4, J5, and J6 - HSSI Connectors

Label	J4 - HSSI0 (X & A axes)
	J5 - HSSI1 (Y & B axes)
	J6 - HSSI2 (Z & C axes)
Connector Type	RJ45 8-pin sockets
Mating Type	RJ45 8-pin plug

The pinout of the sockets is given in the following table:

Table 4-64. J4, J5, and J6 - HSSI Pinout

Pin #	Signal Designator	Description
1	CONTROL_$+	Control signal non-inverted output for channel 0
2	CONTROL_$-	Control signal inverted output for channel 0
3	SER_DI_$+	Serial data non-inverted input for channel 0
4	SER_DI_$-	Serial data inverted input for channel 0
5	SER_DO_$+	Serial data non-inverted output for channel 0
6	SER_DO_$-	Serial data inverted output for channel 0
7	DGND	Digital ground for 5L

Pin #	Signal Designator	Description
8	DGND	Digital ground for 5L

4.2.5.9 J2 and J3 - Ethernet Connectors

Label	J2 - ETH1 J3 - ETH2
Connector Type	RJ45 8-pin socket
Mating Type	RJ45 8-pin plug

The pinout of the sockets is given in the following table:

Table 4-65. J2 and J3 - Ethernet Pinout

Pin #	Signal Designator	Description
1	ETH$_TX+	Positive transmit signal
2	ETH$_TX -	Negative transmit signal
3	ETH$_RX +	Positive receive signal
4	-	Not connected
5	-	Not connected
6	ETH$_RX -	Negative receive signal
7	-	Not connected
8	-	Not connected

4.2.5.10 J19 and J20 RS-232 Communication Connectors

Label	J19 - COM1 J20 - COM2
Connector Type	D-type 9-pin male sockets
Mating type	D-type 9-pin female

When necessary, use COM2 to run the MMI Application Studio Upgrade and Recovery Wizard Recovery Task (see the MMI Application Studio User Guide for details).

The pinout for the sockets is given in the following table:

Table 4-66. J19 and J20 - RS-232 Communication Pinout

Pin #	Signal Designator	Description
1	SHIELD	Cable shield connection
2	RX232	RS-232 receive signal for the communication port (J19 for COM1, and J20 for COM2)
3	TX232	RS-232 transmit signal for communication port (J19 for COM1, and J20 for COM2).
4	-	Not connected
5	DGND	Digital ground.
6	-	Not connected
7	-	Not connected
8	-	Not connected
9	-	Not connected

4.2.5.11 J14 - Drive Supply Voltage Connector

Label	J14 - DRIVE SUPPLY
Connector Type	Phoenix FRONT 4V-7,62
Mating Type	None (screw terminal)

AC power is provided through J14. The pinout for J14 is provided in the following table:

Table 4-67. J14 - Drive Supply Voltage Pinout

Pin #	Signal Designator	Description	Remarks
1	EGND	Earth Ground (shield)	
2	L3	AC input phase L3	
3	L2	AC input phase L2	When using AC single-phase, the voltage has to be connected between L1 and L2.
4	L1	AC input phase L1	

4.2.5.12 J1 - 24V Logic Supply Connector

Label	J1 - 24V LOGIC SUPPLY
Connector Type	Phoenix MCV-1.5/5 GF 3.81
Mating Type	Phoenix MC-1.5/5 STF- 3.81

24Vdc is provided through J1. The J1 pinout is provided in the following table:

Table 4-68. J1 - 24V Logic Supply Pinout

Pin #	Signal Designator	Description
1	24V_SUP	24V logic supply
2	24V_RTN	24V logic supply return
3	5V_ENC_EXT	External 5V supply for encoder
4	5V_ENC_EXT_RTN	External 5V supply return for encoder
5	EGND	Electrical Ground

4.2.5.13 J40 - External Drive Control Signals

Label	J40 - EXTERNAL DRIVE
Connector Type	D-type HD 15-pin female
Mating Type	D-type HD 15-pin male

J40 serves for supplying control signals to external drives.

The J40 pinout is given in the following table:

Table 4-69. J40 - External Drive Control Signals Pinout

Pin #	Signal Designator	Description
1	T_CMD0+	T(5) Drive Command 0+
2	T_CMD0-	T(5) Drive Command 0-
3	T_CMD1+	T(5) Drive Command 1+
4	T_CMD1-	T(5) Drive Command 1-
5	T_ENA	T(5) axis enable signal
6	D_CMD0+	D(7) Drive Command 0+
7	D_CMD0-	D(7) Drive Command 0-
8	D_CMD1+	D(7) Drive Command 1+
9	D_CMD1-	D(7) Drive Command 1-
10	T_FLT	T(5) axis fault signal
11	AGND	Analog ground
12	DGND	Digital ground
13	5U	5V user supply for digital encoder and Hall sensor
14	D_ENA	D(7) axis enable signal
15	D_FLT	D(7) axis fault signal

4.2.5.14 J152_$ - Motor Drive Output

Label	J152_X(0)
	J152_Y(1)
	J152_A(2)
	J152_B(3)
Connector Type	Phoenix PCV 4/4-G-7,62-BK
Mating Type	Phoenix PC 4/ 4-STF-7,62

The connectors are allocated as follows:

Connector	Axis	Connector	Axis
J152_X	X(0)	J152_A	A(2)
J152_Y	Y(1)	J152_B	B(3)

The J152_$ pinout is given in the following table:

Table 4-70. J152_$ - Motor Drive Pinout

Pin #	Signal Designator	Description
1	EGND	Shield
2	$_R	Motor $ R phase
3	$_S	Motor $ S phase
4	$_T	Motor $ T phase

The following diagrams illustrate how motors are to be connected:

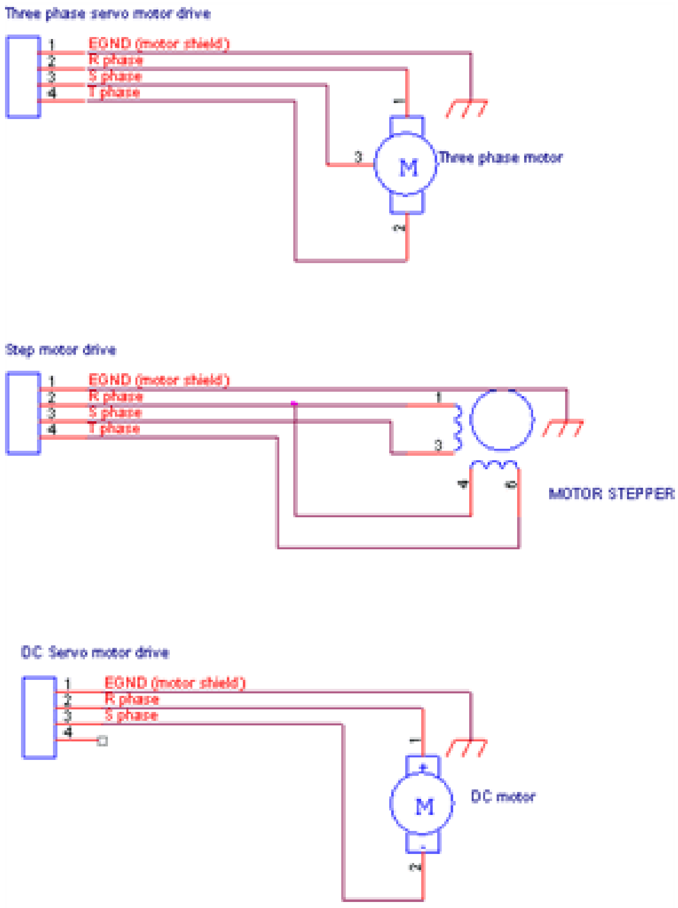


Figure 4-15. MB5U-ZZW J152 Motor Drive Connections

4.2.5.15 J125 - External DC Drive Supply Input

Label	J125 -EXTERNAL DC
Connector Type	Phoenix EMSTBV 2,5/2-GF-BK
Mating Type	Phoenix MSTB2,5/2-STF-BK

In order to avoid damaging the power supply modules, before connecting the voltage, make sure that the following power supplies are not incorporated in the configuration:

- PSM3U-48V-1.4kW
- PSM3U-320/48v-0.7/8KkW

J125 serves for supplying input to an external DC drive.

This connector is valid only if the DDM3U-4-60 Motor Drive is installed.

The J125 pinout is given in the following table:

Table 4-71. J125 - External DC Drive Support Pinout

Pin #	Signal Designator	Description
1	VP_2	24-48V external supply for DDM3U-4-60
2	VP2_RTN	Drive supply return

4.2.5.16 J121 - J124 Low-Power Motor Connectors

Label	J121(D0)
	J122(D1)
	J123(D2)
	J124(D3)
Connector Type	Phoenix MCV-1.5/4 GF 3.
Mating Type	Phoenix MC-1.5/4 STF- 3.81

The connectors are allocated as follows:

Connector	Axis	Connector	Axis
J122 (D1)	Drive Y(1)	J124 (D3)	Drive B(3)
J121 (D0)	Drive X(0)	J123 (D2)	Drive A(2)

The pinout for the Low-Power Motor Drive connectors is given in the following table:

Table 4-72. J121-J124 - Low-Power Motor Pinout

Pin #	Signal Designator	Description
1	R_$	Motor $ R phase
2	S_$	Motor $ S phase
3	T_$	Motor $ T phase
4	EGND	Electrical Ground

The following diagrams illustrate how motors are to be connected:

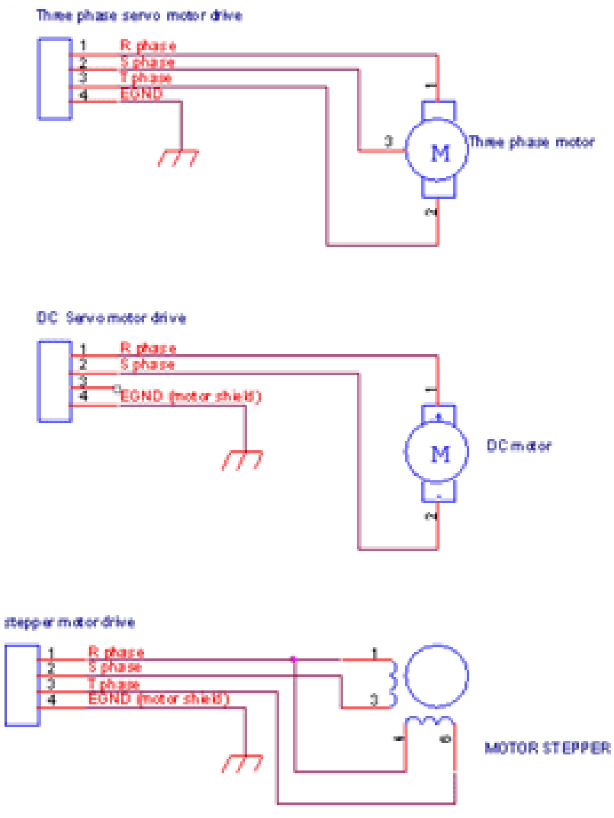


Figure 4-16. MB5U-ZZW J121-J124 Motor Drive Connections

4.2.5.17 MB5U-ZZW Jumpers

> Only a qualified technician should make any changes to the factory settings of the jumpers. Remove the back cover of the unit to access the jumpers.

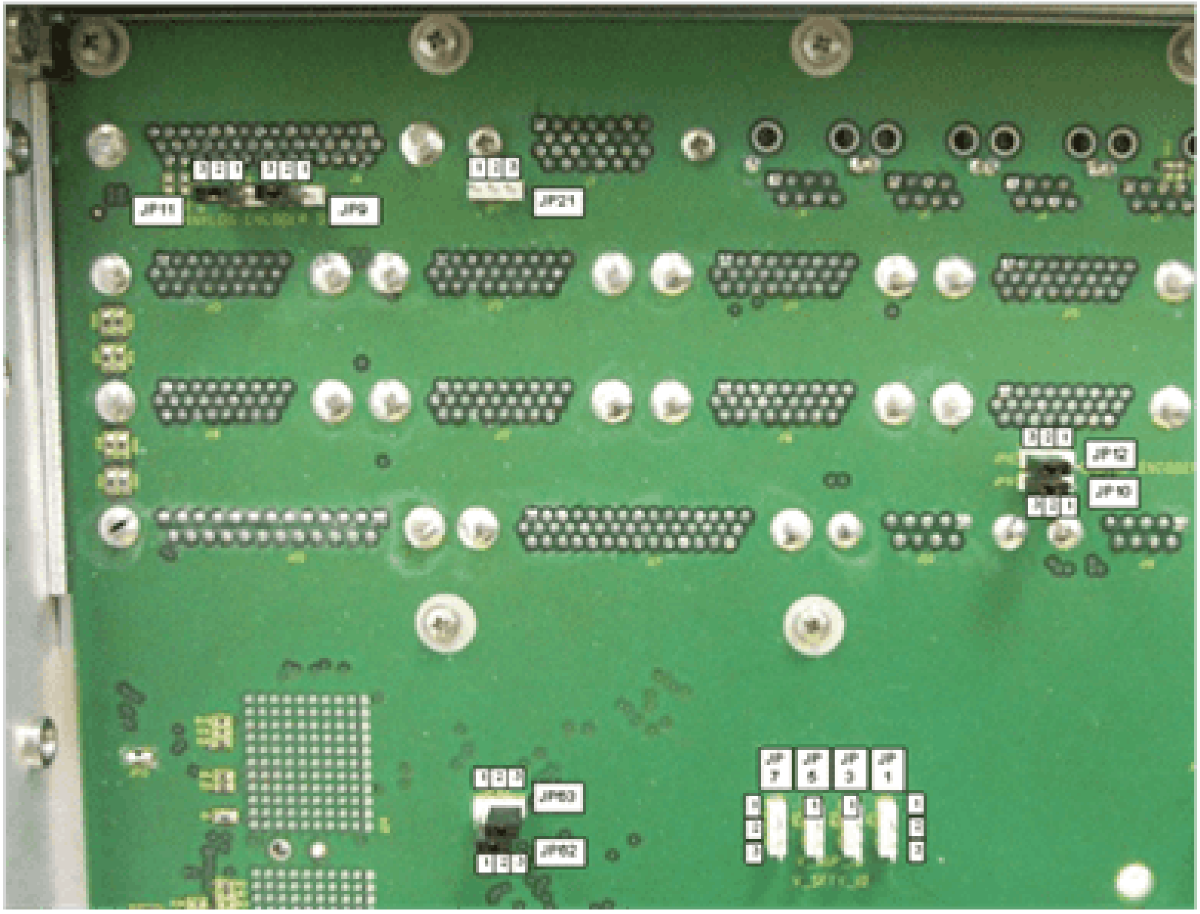


Figure 4-17. MB5U-ZZW Motherboard Jumpers and Pin Numbers

The following table provides details of the settings of the MB5U-ZZW jumpers.

Table 4-73. MB5U-ZZW Jumpers

Name	Description	Functionality	Use for
JP1	5/24Vdc internal Safety supply	1-2 5Vdc internal 2-3 24Vdc internal	Safety supply configuration
JP3	5/24Vdc internal I/O supply	1-2 5Vdc internal 2-3 24Vdc internal	IO supply configuration

Name	Description	Functionality	Use for
JP5	24_RTN/ DGND IO supply return	1-2 DGND 2-3 24V_RTN	IO supply configuration
JP7	24_RTN/ DGND safety supply return	1-2 DGND 2-3 24V_RTN	Safety supply configuration
JP9	Internal or external analog encoder supply	1-2 External 2-3 Internal	Encoder supply
JP10	Internal or external digital encoder supply	1-2 External 2-3 Internal	Encoder supply
JP11	Internal or external analog encoder supply return	1-2 External 2-3 Internal (AGND)	Encoder supply
JP21	Encoder external supply return common ground	1-2 encoder external supply connect to AGND 2-3 encoder external supply connect to DGND	Encoder supply
JP12	Internal or external digital encoder supply return	1-2 External 2-3 Internal (DGND)	Encoder supply
JP13	Digital ground to shield connection	Install – galvanic connection between digital ground to shield	Internal use only
JP14	Digital ground to analog ground connection	Install – galvanic connection between digital ground to analog ground	Internal use only

If an internal power supply is used for safety or I/O, do not connect an external power supply to the V_SUP_SFTY/V_RTN_SFTY of the Encoder connectors or the OUT of the Digital Output connectors.

Table 4-74. Default Jumper Settings

Jumper	Setting
JP1	Open
JP3	Open
JP5	Open
JP7	Open
JP9	2-3
JP10	2-3
JP11	2-3
JP12	2-3
JP21	2-3

4.2.6 MB4U-ZZW-AX7

The MB4U-ZZW-AX7 is installed in the MC4U-13-Piano-AX7.

The connectors associated with the MB4U--ZZW-AX7 motherboard are shown in the following figure:.

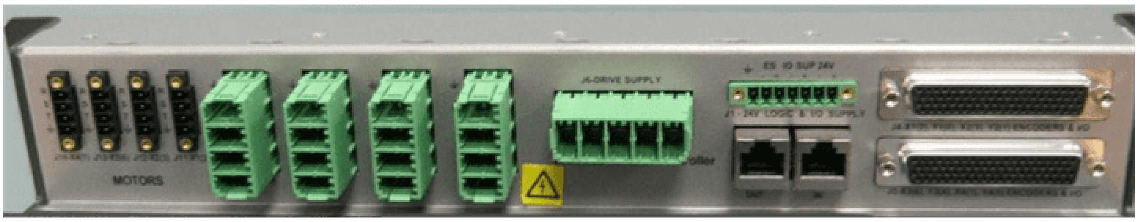


Figure 4-18. MB4U-ZZW-AX7 Connectors

4.2.6.1 MB4U-ZZW-AX7 Functionality

The MB4U-ZZW-AX7 accommodates the SPiiPlusDC-LT motion controller (4 or 8 axes), up to three DDM3U-X-320V-YY drives and one PSM3U-320V-4/8kW power supply. It supports the following functionality:

> 4 x Digital encoders if the 4-axis SPiiPlusDC-LT controller is installed

8 x Digital encoders if the 8-axis SPiiPlusDC-LT controller is installed

> 4 x Motor Temperature sensors if the 4-axis SPiiPlusDC-LT controller is installed

> 8 x Motor Temperature sensors if the 8-axis SPiiPlusDC-LT controller is installed

> 4 x Safety inputs if the 4-axis SPiiPlusDC-LT controller is installed

> 8 x Safety inputs sensors if the 8-axis SPiiPlusDC-LT controller is installed

- 4 x Digital outputs if the 4-axis SPiiPlusDC-LT controller is installed
  8 x Digital outputs sensors if the 8-axis SPiiPlusDC-LT controller is installed
- 4 x Analog inputs if the 4-axis SPiiPlusDC-LT controller is installed
  8 x Analog inputs if the 8-axis SPiiPlusDC-LT controller is installed
- 4 x PEG signals if the 4-axis SPiiPlusDC-LT controller is installed
  8 x PEG signals if the 8-axis SPiiPlusDC-LT controller is installed
- 2 x HSSI channels if the 4-axis SPiiPlusDC-LT controller is installed
  4 x HSSI channels if the 8-axis SPiiPlusDC-LT controller is installed
- 2 x RJ-45 channels

4.2.6.2 J1 - 24V Logic & I/O Supply Connector

Label	J1 - 24V LOGIC & I/O SUPPLY
Connector Type	Phoenix MCV 1,5/7-GF-3,81, 7-pin header pitch
Mating Type	Phoenix MC 1,5/ 7-STF-3,81, 7-pin plug pitch

The pinout for J1 is given in the following table:

Table 4-75. 24V Logic Supply Connector Pinout

Pin #	Signal Designator	Description
1	24V_SUP	24V logic supply
2	24V_RTN	24V logic supply return
3	IO_SUP	5/24V supply for I/O and Safety inputs
4	IO_RTN	5/24V return for I/O and Safety inputs
5	ES+	Emergency Stop non-inverted
6	ES-	Emergency Stop inverted
7	EGND	Shield

4.2.6.3 J2 - EtherCAT® OUT Connector

Label	J2 - ETHERCAT OUT
Connector Type	RJ45 8-pin socket
Mating Type	RJ45 8-pin plug

The pinout for J2 is given in the following table:

Table 4-76. EtherCAT Out Connector Pinout

Pin #	Signal Designator	Description
1	ETH_OUT_TX+	Positive transmit signal
2	ETH_OUT_TX -	Negative transmit signal
3	ETH_OUT_RX +	Positive receive signal
4	-	Not connected
5	-	Not connected
6	ETH_OUT_RX -	Negative receive signal
7	-	Not connected
8	-	Not connected

4.2.6.4 J3 - Ether Cat IN Connector

Label	J3 - ETHERCAT IN
Connector Type	RJ45 8-pin socket
Mating Type	RJ45 8-pin plug

The pinout for J3 is given in the following table:

Table 4-77. EtherCAT In Pinout

Pin #	Signal Designator	Description
1	ETH_IN_TX+	Positive transmit signal
2	ETH_IN_TX -	Negative transmit signal
3	ETH_IN_RX +	Positive receive signal
4	-	Not connected
5	-	Not connected
6	ETH_IN_RX -	Negative receive signal
7	-	Not connected
8	-	Not connected

4.2.6.5 J4 - Encoder Connector

Label	J4 - X(0), Y(1), A(2), B(3) ENCODERS & I/O
Connector Type	D-SUB HD-type, 78-pin, female
Mating Type	D-type 78-pin HD male

The pinout for J4 is given in the following table:

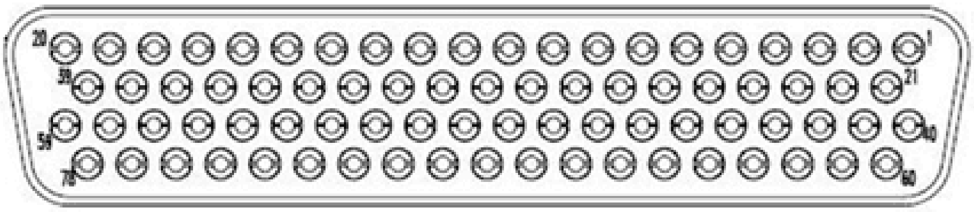


Table 4-78. J4 - Encoder Pinout

Pin	Signal Designator	Description
1	Shield	Shield
2	B_CHA+	Axis 3 Encoder A(2) non-inverted input
3	B_CHB+	Axis 3 Encoder B(3) non-inverted input
4	B_CHI+	Axis 3 Encoder index non-inverted input
5	DGND	Internal digital supply return
6	Y_CHA+	Axis Y(1) Encoder A(2) non-inverted input
7	Y_CHB+	Axis Y(1) Encoder B(3) non-inverted input
8	Y_CHI+	Axis Y(1) Encoder index non-inverted input
9	AIN14+	Analog input non-inverted
10	AIN11+	Analog input non-inverted
11	AGND	Analog ground
12	AIN10+	Analog input non-inverted
13	X_CHI+	Axis X(0) Encoder index non-inverted input
14	X_CHB+	Axis X(0) Encoder B(3) non-inverted input

Pin	Signal Designator	Description
15	X_CHA+	Axis X(0) Encoder A(2) non-inverted input
16	DGND	Internal digital supply return
17	A_CHI+	Axis A(2) Encoder index non-inverted input
18	A_CHB+	Axis A(2) Encoder B(3) non-inverted input
19	A_CHA+	Axis A(2) Encoder A(2) non-inverted input
20	Shield	Shield
21	B_OVER_T	Axis B(3) Motor temperature sensor input.
22	B_CHA-	Axis B(3) Encoder A(2) inverted input
23	B_CHB-	Axis B(3) Encoder B(3) inverted input
24	B_CHI-	Axis B(3) Encoder index inverted input
25	Y_OVER_T	Axis Y(1) Motor temperature sensor input.
26	Y_CHA-	Axis Y(1) Encoder A(2) inverted input
27	Y_CHB-	Axis Y(1) Encoder B(3) inverted input
28	Y_CHI-	Axis Y(1) Encoder index inverted input
29	AIN14-	Analog input inverted
30	AIN11-	Analog input inverted
31	AIN10-	Analog input inverted
32	X_CHI-	Axis X(0) Encoder index inverted input
33	X_CHB-	Axis X(0) Encoder B(3) inverted input
34	X_CHA-	Axis X(0) Encoder A(2) inverted input
35	X_OVER_T	Axis X(0) Motor temperature sensor input.
36	A_CHI-	Axis A(2) Encoder index inverted input
37	A_CHB-	Axis A(2) Encoder B(3) inverted input
38	A_CHA-	Axis A(2) Encoder A(2) inverted input

Pin	Signal Designator	Description
39	A_OVER_T	Axis A(2) Motor temperature sensor input.
40	V_SUP_IO	Input/Output Supply+
41	OUT1	Digital Output 1
42	OUT2	Digital Output 2
43	IN2	Digital Input 2
44	B_RL	Axis 3 Right Limit
45	SER_DO_1+	HSSI1 serial data non-inverted output
46	SER_DI_1+	HSSI1 serial data non-inverted input
47	CONTROL_1+	HSSI1 control signal non-inverted output
48	Y_PEG+	PEG Digital output non-inverted
49	AGND	Analog ground
50	AIN11+	Analog input non-inverted
51	X_PEG+	PEG Digital output non-inverted
52	CONTROL_0+	HSSI0 control signal non-inverted output
53	SER_DI_0+	HSSI0 serial data non-inverted input
54	SER_DO_0+	HSSI0 serial data non-inverted output
55	A_RL	Axis 2 Right Limit
56	IN0	Digital Input 0
57	OUT2	Digital Output 2
58	OUT0	Digital Output 0
59	V_SUP_IO	Input/Output Supply+
60	V_RTN_IO	Input/Output Supply Return
61	OUT3	Digital Output 3
62	OUT4	Digital Output 4

Pin	Signal Designator	Description
63	IN3	Digital Input 3
64	Y_RL	Axis 1 Right Limit
65	SER_DO_1-	HSSI1 serial data inverted output
66	SER_DI_1-	HSSI1 serial data inverted input
67	CONTROL_1-	HSSI1 control signal inverted output
68	Y_PEG-	Axis 1 PEG Digital output inverted
69	AIN11-	Analog input inverted
70	X_PEG-	Axis 0 PEG Digital output inverted
71	CONTROL_0-	HSSI0 control signal inverted output
72	SER_DI_0-	HSSI0 serial data inverted input
73	SER_DO_0-	HSSI0 serial data inverted output
74	X_RL	Axis 0 Right Limit
75	IN1	Digital Input 1
76	OUT4	Digital Output 4
77	OUT3	Digital Output 3
78	V_RTN_IO	Input/Output Supply Return

4.2.6.6 J5 - Encoder Connector

Label	J5 - Z(4), T(5), C(6), D(7) ENCODERS & I/O
Connector Type	D-SUB HD-type, 78-pin, female
Mating Type	D-type 78-pin HD male

The pinout for J5 is given in the following table:

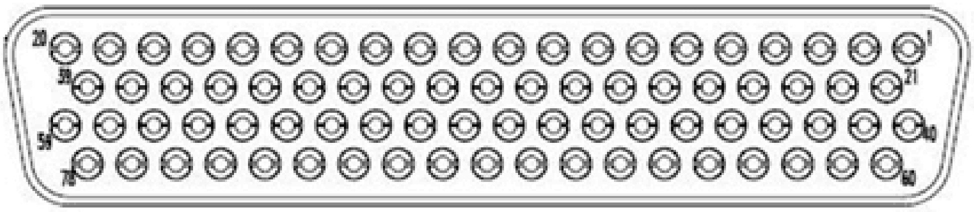


Table 4-79. J5 - Encoder Pinout

Pin	Signal Designator	Description
1	Shield	Shield
2	C_CHA+	Axis C(6) Encoder A(2) non-inverted input
3	C_CHB+	Axis C(6) Encoder B(3) non-inverted input
4	C_CHI+	Axis C(6) Encoder index non-inverted input
5	DGND	Internal digital supply return
6	Z_CHA+	Axis Z(4) Encoder A(2) non-inverted input
7	Z_CHB+	Axis Z(4) Encoder B(3) non-inverted input
8	Z_CHI+	Axis Z(4) Encoder index non-inverted input
9	-	Not connected
10	AIN115+	Analog input non-inverted
11	AGND	Analog ground
12	-	Not connected
13	T_CHI+	Axis T(5) Encoder index non-inverted input
14	T_CHB+	Axis T(5) Encoder B(3) non-inverted input
15	T_CHA+	Axis T(5) Encoder A(2) non-inverted input
16	DGND	Internal digital supply return
17	D_CHI+	Axis D(7) Encoder index non-inverted input
18	D_CHB+	Axis D(7) Encoder B(3) non-inverted input
19	D_CHA+	Axis D(7) Encoder A(2) non-inverted input
20	Shield	Shield

Pin	Signal Designator	Description
21	C_OVER_T	Axis C(6) Motor temperature sensor input.
22	C_CHA-	Axis C(6) Encoder A(2) inverted input
23	C_CHB-	Axis C(6) Encoder B(3) inverted input
24	C_CHI-	Axis C(6) Encoder index inverted input
25	Z_OVER_T	Axis Z(4) Motor temperature sensor input.
26	Z_CHA-	Axis Z(4) Encoder A(2) inverted input
27	Z_CHB-	Axis Z(4) Encoder B(3) inverted input
28	Z_CHI-	Axis Z(4) Encoder index inverted input
29	-	Not connected
30	AIN15-	Analog input inverted
31	-	Not connected
32	T_CHI-	Axis T(5) Encoder index inverted input
33	T_CHB-	Axis T(5) Encoder B(3) inverted input
34	T_CHA-	Axis T(5) Encoder A(2) inverted input
35	T_OVER_T	Axis T(5) Motor temperature sensor input.
36	D_CHI-	Axis D(7) Encoder index inverted input
37	D_CHB-	Axis D(7) Encoder B(3) inverted input
38	D_CHA-	Axis D(7) Encoder A(2) inverted input
39	D_OVER_T	Axis D(7) Motor temperature sensor input.
40	V_SUP_IO	Input/Output Supply+
41	OUT1	Digital Output 1
42	OUT2	Digital Output 2
43	IN4	Digital Input 2
44	C_RL	Axis C(6) Right Limit

Pin	Signal Designator	Description
45	SER_DO_2+	HSSI2 serial data non-inverted output
46	SER_DI_2+	HSSI2 serial data non-inverted input
47	CONTROL_2+	HSSI2 control signal non-inverted output
48	T_PEG+	Axis T(5) PEG Digital output non-inverted
49	AGND	Analog ground
50	AIN11+	Analog input non-inverted
51	T_PEG+	Axis T(5) PEG Digital output non-inverted
52	-	Not connected
53	-	Not connected
54	-	Not connected
55	D_RL	Axis D(7) Right Limit
56	IN6	Digital Input 6
57	OUT2	Digital Output 2
58	OUT0	Digital Output 0
59	V_SUP_IO	Input/Output Supply+
60	V_RTN_IO	Input/Output Supply Return
61	OUT3	Digital Output 3
62	OUT4	Digital Output 4
63	IN5	Digital Input 5
64	Z_RL	Axis Z(4) Right Limit
65	SER_DO_2-	HSSI2 serial data inverted output
66	SER_DI_2-	HSSI2 serial data inverted input
67	CONTROL_2-	HSSI2 control signal inverted output
68	Z_PEG-	Axis Z(4) PEG Digital output inverted

Pin	Signal Designator	Description
69	AIN15-	Analog input inverted
70	T_PEG-	Axis T(5) PEG Digital output inverted
71	-	Not connected
72	-	Not connected
73	-	Not connected
74	T_RL	Axis T(5) Right Limit
75	IN7	Digital Input 7
76	OUT4	Digital Output 4
77	OUT3	Digital Output 3
78	V_RTN_IO	Input/Output Supply Return

4.2.6.7 J6 - Drive Supply Connector

Label	J6 - DRIVE SUPPLY
Connector Type	Phoenix PCV 5/ 5-G-7,62 5-pin header pitch 7.62mm
Mating Type	Phoenix PC 5/ 5-STCL1-7,62 5-pin plug with lockers pitch 7.62mm

The pinout for J6 is given in the following table:

Table 4-80. J6 - Drive Supply Pinout

Pin #	Signal Designator	Description
1	L1	AC input phase L1
2	L2	AC input phase L2
3	L3	AC input phase L3
4	-	Not connected
	EGND	Earth ground (shield)

4.2.6.8 J7-J10 - Motor Connectors

Label	J7- X(0) MOTOR
	J8 - Y(1) MOTOR
	J9 - Z(4) MOTOR
	J10 - T(5) MOTOR
Connector Type	Phoenix PCV 5/ 4-G-7,62 4-pin header pitch
Mating Type	Phoenix PC 5/ 4-STCL1-7,62 4-pin plug with lockers pitch

The axis to which the connectors are connected is specified in the following table:

Connector	Axis	Connector	Axis
J7	X(0)	J9	Z(4)
J8	Y(1)	J10	T(5)

The pinout for J7 - J10 is given in the following table:

> The value of $ in the Signal Designator depends on the connector. For connector J7, $ is 0, for connector J8, $ is 1, and so forth.

Table 4-81. J7-J10 - Drive Supply Pinout

Pin #	Signal Designator	Description
1	EGND	Earth ground (shield)
2	R$	Motor $, R phase
3	S$	Motor $, S phase
4	T$	Motor $, T phase

4.2.6.9 J11-J14 - Motor Connectors

Label	J11 - A(2) MOTOR
	J12 - B(3) MOTOR
	J13 - C(6) MOTOR
	J14 - D(7) MOTOR

Connector Type	Phoenix MCV 1,5/4-GF-3,81 4-pin header pitch
Mating Type	Phoenix MC 1,5/ 4-STF-3,81 4-pin plug with lockers pitch

The axis to which the connectors are connected is specified in the following table:

Connector	Axis	Connector	Axis
J11	2	J13	6
J12	3	J14	7

The pinout for J11 - J14 is given in the following table:

> The value of $ in the Signal Designator depends on the connector. For connector J11, $ is 2, for connector J12, $ is 3, and so forth.

Table 4-82. J11-J14 - Drive Supply Pinout

Pin #	Signal Designator	Description
1	EGND	Earth ground (shield)
2	R$	Motor $, R phase
3	S$	Motor $, S phase
4	T$	Motor $, T phase

4.2.7 MB5U-YYYY

The MB5U-YYYY is installed in the MC4U-19-Piano-enc.

The connectors associated with the MB5U-YYYY motherboard are shown in the following figure:

Figure 4-19. MB5U-YYYY Connectors

4.2.7.1 MB5U-YYYY Functionality

The MB5U-YYYY accommodates any SPiiPlus Motion Controller, four DDM3U-2-320V-XX (up to 10A/20A) drives and one PSM3U-320V-8KW power supply. It supports the following functionality:

- 8 x Digital encoders
- 8 x SIN-COS encoders (optional)

> 8 x Hall effect sensors
> 8 x Motor Temperature sensors
> 16 x Safety inputs
> 1 x E-stop
> 8 x Digital outputs/Mechanical brakes
> 8 x Digital inputs
> 4 x Analog I/O
> 5 x MARK signals
> 1 x Squared SIN-COS signals for axes 0(X), 2(A), 1(Y), 3(B)
> 4 x PEG signals, plus 3 x STATE signals
> 8 x Motor output signals
> 2 x Ethernet channels
> 3 x HSSI channels
> 2 x RS-232 channels
> 2 x External Drive Control (T & D)

4.2.7.2 Encoder and Hall Connectors

Label	J10-T(5) ENC
	J11-Z(4) ENC
	J12-Y(1) ENC
	J13-X(0) ENC
	J15-D(7) ENC
	J16-C(6) ENC
	J17-B(3) ENC
	J18-A(2) ENC
Connector Type	D-type 26-pin HD female
Mating Type	D-type 26-pin HD male (for easy prototyping a Phoenix FLKM HDSUB-26/M Sub-D to Screw Terminal converter can be used)

The connectors are allocated as follows:

Connector	Axis	Connector	Axis
J10 - T ENC	T(5)	J15 - D ENC	D(7)
J11 - Z ENC	Z(4)	J16 - C ENC	C(6)
J12 - Y ENC	Y(1)	J17 - B ENC	B(3)
J13 - X ENC	X(0)	J18 - A ENC	A(2)

The pinout for the Encoder/Hall Connectors is given in the following table:

The dollar sign ($) stands for the given axis, for example, $_LL can be X_LL, or Y_LL, etc.

Table 4-83. Encoder/Hall Pinout

Pin	Signal Designator	Description
1	$_CHA-	Encoder A(2) inverted input
2	$_CHB-	Encoder B(3) inverted input
3	$_CHI-	Encoder index inverted input
4	$_HB	Motor Hall B
5	V_SUP_SFTY	Supply for the limits input
6	$_RL	Right limit
7	$_SIN-	Encoder SIN inverted input
8	$_COS-	Encoder COS inverted input
9	$_SC_I-	Encoder SIN-COS Index inverted input
10	$_CHA+	Encoder A(2) non-inverted input
11	$_CHB+	Encoder B(3) non-inverted input
12	$_CHI+	Encoder Index non-inverted input
13	$_HA	Motor Hall A
14	$_HC	Motor Hall C

Pin	Signal Designator	Description
15	$_LL	Left limit
16	$_SIN+	SIN non-inverted input
17	$_COS+	Encoder COS non-inverted input
18	$_SC_I+	Encoder SIN-COS Index non-inverted input
19	5U	5V user supply for the digital encoder and Hall
20	5U_RTN	5V return user supply for the digital encoder and Hall
21	Shield	Shield
22	$_MTMP	Motor temperature sensor input
23	V_RTN_IO	A return for the Motor temperature sensor
24	V_RTN_SFTY	A return for the limits input
25	5F	5V user supply for the analog encoder and Hall
26	5F_RTN	5V return user supply for the analog encoder and Hall

4.2.7.3 J7 - Squared SIN-COS Connector

Label	J7 - SQUARED SIN-COS
Connector Type	3M, 10226-6212PC Mini D Ribbon (MDR), 26-pin female
Mating Type	3M, 10126-3000-PE Mini D Ribbon (MDR), 26-pin male

The pinout for J7 is given in the following table:

Table 4-84. J7 - Squared Sin-Cos Pinout

Pin #	Signal Designator	Description
1	X_CHA+	X(0) Channel A(2) non-inverted digital encoder output
2	X_CHA-	X(0) Channel A(2) inverted digital encoder output
3	X_CHB+	X(0) Channel B(3) non-inverted digital encoder output
4	X_CHB-	X(0) Channel B(3) inverted digital encoder output
5	X_CHI+	Not Used

Pin #	Signal Designator	Description
6	X_CHI-	Not Used
7	A_CHA+	Not Used
8	A_CHA-	Not Used
9	A_CHB+	Not Used
10	A_CHB-	Not Used
11	A_CHI+	Not Used
12	A_CHI-	Not Used
13	DGND	Internal digital supply return
14	Y_CHA+	Y(1) Channel A(2) non-inverted digital encoder output
15	Y_CHA-	Y(1) Channel A(2) inverted digital encoder output
16	Y_CHB+	Y(1) Channel B(3) non-inverted digital encoder output
17	Y_CHB-	Y(1) Channel B(3) inverted digital encoder output
18	Y_CHI+	Not Used
19	Y_CHI-	Not Used
20	B_CHA-	Not Used
21	B_CHB+	Not Used
22	B_CHB-	Not Used
23	B_CHI+	Not Used
24	B_CHI-	Not Used
25	B_CHA-	Not Used
26	-	Not connected

4.2.7.4 J8 - Digital and Analog I/O Connector

Label	J8 - DIGITAL & ANALOG I/O
Connector Type	D-type 44-pin HD male
Mating Type	D-type 44 pin HD female (for easy prototyping a Phoenix FLKM HDSUB-44/M Sub-D to Screw Terminal converter can be used)

J8 serves for controlling Digital and Analog I/O signal formats. The pinout for J8 is given in the following table:

Table 4-85. J8 - Digital and Analog I/O Pinout

Pin #	Signal Designator	Description
1	OUT1	Digital Output 1
2	OUT3	Digital Output 3
3	OUT5	Digital Output 5
4	OUT7	Digital Output 7
5	IN1	Digital Input 1
6	IN3	Digital Input 3
7	AGND	Analog ground
8	AIN10-	Analog input AIN10 inverted
9	AIN11-	Analog input AIN11 inverted
10	AIN14-	Analog input AIN14 inverted
11	AIN15-	Analog input AIN15 inverted
12	AOUT10-	Analog output AOUT10 inverted
13	AOUT11-	Analog output AOUT11 inverted
14	AOUT14-	Analog output AOUT14 inverted
15	AOUT15-	Analog output AOUT15 inverted
16	OUT0	Digital Output 0
17	OUT2	Digital Output 2

Pin #	Signal Designator	Description
18	OUT4	Digital Output 4
19	OUT6	Digital Output 6
20	IN0	Digital Input 0
21	IN2	Digital Input 2
22	-	Not connected
23	AIN10+	Analog input AIN10 non-inverted
24	AIN11+	Analog input AIN11 non-inverted
25	AIN14+	Analog input AIN14 non-inverted
26	AIN15+	Analog input AIN15 non-inverted
27	AOUT10+ (AOUT2+)	Analog output AOUT10 non-inverted
28	AOUT11+ (AOUT6+)	Analog output AOUT11 non-inverted
29	AOUT14+ (AOUT10+)	Analog output AOUT14 non-inverted
30	AOUT15+ (AOUT14+)	Analog output AOUT15 non-inverted
31	V_SUP_IO	Input/Output Supply+
32	V_RTN_IO	Input/Output Supply Return
33	IN4/Z_MARK2	Digital Input 4 (can also be used for Z_MARK2)
34	IN5/T_MARK2	Digital Input 5 (can also be used for T_MARK2)
35	IN6/X_MARK2	Digital Input 6 (can also be used for X_MARK2)
36	IN7/Y_MARK2	Digital Input 7 (can also be used for Y_MARK2)

Pin #	Signal Designator	Description
When employing IN4, IN5, IN6 and/or IN7 for MARK2, the normal delay for Digital Input (< 0.3 μSec) increases to 50 μSec.		
37	AGND	Analog ground
38	AGND	Analog ground
39	-	Not connected
40	-	Not connected
41	-	Not connected
42	+12V1	12V for joystick (optional, need 0Ω resistor) (Not Applicable)
43	12V1_RTN	+-12V return for joystick (optional, need 0Ω resistor) (Not Applicable)
44	-12V1	-12V for joystick (optional, need 0Ω resistor) (Not Applicable)

4.2.7.5 J9 - Regeneration Connector

J9 is relevant only if the PSM3U-320V-XXkW (high-power supply) is being used.

Label	J9 - REGENERATION
Connector Type	Phoenix FRONT 2,5-V/SA 10
Mating Type	None (screw terminal)

The pinout for J9 is provided in the following table:

Table 4-86. J9 - Regeneration Pinout

Pin #	Signal Designator	Description
1	REG1_1	Regeneration resistor for PS 1 (V1 on the motherboard)
2	REG1_2	Regeneration resistor for PS 1
3	REG2_1	Regeneration resistor for PS 2 (V2 on the motherboard)
4	REG2_2	Regeneration resistor for PS 2

4.2.7.6 J21 - Fast I/O (PEG & Mark) Connector

Label	J21 - FAST I/O
Connector Type	D-type 44-pin HD female connector.
Mating Type	D-type 44-pin HD male (for easy prototyping a Phoenix FLKM HDSUB-44/M Sub-D to Screw Terminal converter can be used)

The pinout for J21 is given in the following table:

Table 4-87. J21 - Fast I/O Pinout

Pin #	Signal Designator	Description
1	-	Not connected.
2	-	Not connected
3	-	Not connected
4	X_STATE2+	State Digital output non-inverted
5	X_STATE1+	State Digital output non-inverted
6	X_STATE0+	State Digital output non-inverted
7	-	Not connected
8	-	Not connected
9	DGND	Internal digital supply return
10	DGND	Internal digital supply return
11	T_PEG+	PEG Digital output non-inverted

Pin #	Signal Designator	Description
12	Z_PEG+	PEG Digital output non-inverted
13	Y_PEG+	PEG Digital output non-inverted
14	X_PEG+	PEG Digital output non-inverted
15	-	Not connected.
16	-	Not connected
17	-	Not connected
18	-	Not connected
19	X_STATE2-	State Digital output inverted
20	X_STATE1-	State Digital output inverted
21	X_STATE0-	State Digital output inverted
22	-	Not connected
23	-	Not connected
24	-	Not connected
25	-	Not connected
26	T_PEG-	PEG Digital output inverted
27	Z_PEG-	PEG Digital output inverted
28	Y_PEG-	PEG Digital output inverted
29	X_PEG-	PEG Digital output inverted
30	-	Not connected
31	X_MARK1+	Mark Digital input non-inverted
32	X_MARK1-	Mark Digital input inverted
33	-	Not connected
34	-	Not connected
35	Y_MARK1+	Mark Digital input non-inverted

Pin #	Signal Designator	Description
36	Y_MARK1-	Mark Digital input inverted
37	-	Not connected
38	-	Not connected
39	Z_MARK1+	Mark Digital input non-inverted
40	Z_MARK1-	Mark Digital input inverted
41	-	Not connected
42	-	Not connected
43	T_MARK1+	Mark Digital input non-inverted
44	T_MARK1-	Mark Digital input inverted

4.2.7.7 J22 - Motor Limits Connector

Label	J22 - LIMITS
Connector Type	D-type 25-pin male
Mating Type	D-type 25-pin female (for easy prototyping a Phoenix FLKM HDSUB-25/M Sub-D to Screw Terminal converter can be used)

The pinout for J22 is given in the following table:

Pin #	Signal Designator	Description
1	V_SUP_SFTY	Safety Supply +
2	-	Not connected
3	X_LL	X(0) Left Limit
4	A_LL	A(2) Left Limit
5	Y_LL	Y(1) Left Limit
6	B_LL	B(3) Left Limit
7	Z_LL	Z(4) Left Limit

Pin #	Signal Designator	Description
8	C_LL	C(6) Left Limit
9	T_LL	T(5) Left Limit
10	D_LL	D(7) Left Limit
11	-	Not connected
12	-	Not connected
13	-	Not connected
14	V_RTN_SFTY	Safety Supply Return
15	-	Not connected
16	X_RL	X(0) Right Limit
17	A_RL	A(2) Right Limit
18	Y_RL	Y(1) Right Limit
19	B_RL	B(3) Right Limit
20	Z_RL	Z(4) Right Limit
21	C_RL	C(6) Right Limit
22	T_RL	T(6) Right Limit
23	D_RL	D(7) Right Limit
24	ES+	Emergency stop non-inverted
25	ES-	Emergency stop inverted

4.2.7.8 J4, J5, and J6 - HSSI Connectors

Label	J4 - HSSI0 (X(0) & A(2) axes)
	J5 - HSSI1 (Y(1) & B(3) axes)
	J6 - HSSI2 (Z(4) & C(6) axes)
Connector Type	RJ45 8-pin sockets
Mating Type	RJ45 8-pin plug

The pinout of the sockets is given in the following table:

Pin #	Signal Designator	Description
1	CONTROL_$+	Control signal non-inverted output for channel 0
2	CONTROL_$-	Control signal inverted output for channel 0
3	SER_DI_$+	Serial data non-inverted input for channel 0
4	SER_DI_$-	Serial data inverted input for channel 0
5	SER_DO_$+	Serial data non-inverted output for channel 0
6	SER_DO_$-	Serial data inverted output for channel 0
7	DGND	Digital ground for 5L
8	DGND	Digital ground for 5L

4.2.7.9 J2 and J3 - Ethernet Connectors

Label	J2 - ETH1 J3 - ETH2
Connector Type	RJ45 8-pin socket
Mating Type	RJ45 8-pin plug

The pinout of the sockets is given in the following table:

Table 4-88. J2 and J3 - Ethernet Pinout

Pin #	Signal Designator	Description
1	ETH$_TX+	Positive transmit signal
2	ETH$_TX -	Negative transmit signal
3	ETH$_RX +	Positive receive signal
4	-	Not connected
5	-	Not connected
6	ETH$_RX -	Negative receive signal
7	-	Not connected
8	-	Not connected

4.2.7.10 J19 and J20 RS-232 Communication Connectors

Label	J19 - COM1
	J20 - COM2
Connector Type	D-type 9-pin male sockets
Mating type	D-type 9-pin female

When necessary, use COM2 to run the MMI Application Studio Upgrade and Recovery Wizard Recovery Task (see the MMI Application Studio User Guide for details).

The pinout for the sockets is given in the following table:

Table 4-89. J19 and J20 - RS-232 Communication Pinout

Pin #	Signal Designator	Description
1	SHIELD	Cable shield connection
2	RX232	RS-232 receive signal for the communication port (J19 for COM1, and J20 for COM2)
3	TX232	RS-232 transmit signal for communication port (J19 for COM1, and J20 for COM2).
4	-	Not connected
5	DGND	Digital ground.
6	-	Not connected
7	-	Not connected
8	-	Not connected
9	-	Not connected

4.2.7.11 J14 - Drive Supply Voltage Connector

Label	J14 - DRIVE SUPPLY
Connector Type	Phoenix FRONT 4V-7,62
Mating Type	None (screw terminal)

AC power is provided through J14. The pinout for J14 is provided in the following table:

Table 4-90. J14 - Drive Supply Voltage Pinout

Pin #	Signal Designator	Description	Remarks
1	EGND	Earth Ground (shield)	
2	L3	AC input phase L3	
3	L2	AC input phase L2	When using AC single-phase, the voltage has to be connected between L1 and L2.
4	L1	AC input phase L1	

4.2.7.12 J1 - 24V Logic Supply Connector

Label	J1 - 24V LOGIC SUPPLY
Connector Type	Phoenix MCV-1.5/5 GF 3.81
Mating Type	Phoenix MC-1.5/5 STF- 3.81

24Vdc is provided through J1. The J1 pinout is provided in the following table:

Table 4-91. J1 - 24V Logic Supply Pinout

Pin #	Signal Designator	Description
1	24V_SUP	24V logic supply
2	24V_RTN	24V logic supply return
3	5V_ENC_EXT	External 5V supply for encoder
4	5V_ENC_EXT_RTN	External 5V supply return for encoder
5	EGND	Electrical Ground

4.2.7.13 J40 - External Drive Control Signals

Label	J40 - ETERNAL DRIVE
Connector Type	D-type HD 15-pin female
Mating Type	D-type HD 15-pin male

J40 serves for supplying control signals to external drives.

The J40 pinout is given in the following table:

Table 4-92. J40 - External Drive Control Signals Pinout

Pin #	Signal Designator	Description
1	T_CMD0+	T(5) Drive Command 0+
2	T_CMD0-	T(5) Drive Command 0-
3	T_CMD1+	T(5) Drive Command 1+
4	T_CMD1-	T(5) Drive Command 1-
5	T_ENA	T(5) axis enable signal
6	D_CMD0+	D(7) Drive Command 0+
7	D_CMD0-	D(7) Drive Command 0-
8	D_CMD1+	D(7) Drive Command 1+
9	D_CMD1-	D(7) Drive Command 1-
10	T_FLT	T(5) axis fault signal
11	AGND	Analog ground
12	DGND	Digital ground
13	5U	5V user supply for digital encoder and Hall sensor
14	D_ENA	D(7) axis enable signal
15	D_FLT	D(7) axis fault signal

Drive Enable Example

The following example illustrates the drive enable interface for a D(7) axis direct-connected servo drive. The same interface applies for direct-connected stepper drives.

The value of the pull-up or pull-down resistor must ensure that the enable output current does not exceed the controller's rated maximum current (50mA).

The following illustration is an example (for the D(7) axis) of an enable output connection to a **source-type** input on a servo drive, the drive having **internal** pull-down resistor. When the drive receives external volt (up to 24Vdc), it becomes enabled.

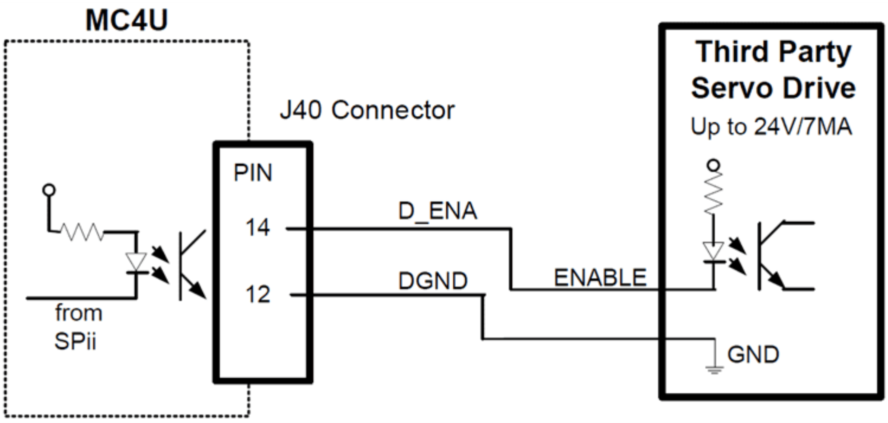


Figure 4-20. Source-Type Drive Enable Output (D Axis)

4.2.7.14 J152_$ - Motor Drive Output Connectors

Label	J152_X(0)
	J152_Y(1)
	J152_Z(4)
	J152_T(5)
	J152_A(2)
	J152_B(3)
	J152_C(6)
	J152_D(7)
Connector Type	Phoenix PCV 4/4-G-7,62-BK
Mating Type	Phoenix PC 4/ 4-STF-7,62

The connectors are allocated as follows:

Connector	Axis	Connector	Axis
J152_X	X(0)	J152_A	A(2)
J152_Y	Y(1)	J152_B	B(3)
J152_Z	Z(4)	J152_C	C(6)
J152_T	T(5)	J152_D	D(7)

The J152_$ pinout is given in the following table:

Table 4-93. J152_$ - Motor Drive Output Pinout

Pin #	Signal Designator	Description
1	EGND	Shield
2	$_R	Motor $ R phase
3	$_S	Motor $ S phase
4	$_T	Motor $ T phase

The following diagrams illustrate how motors are to be connected:

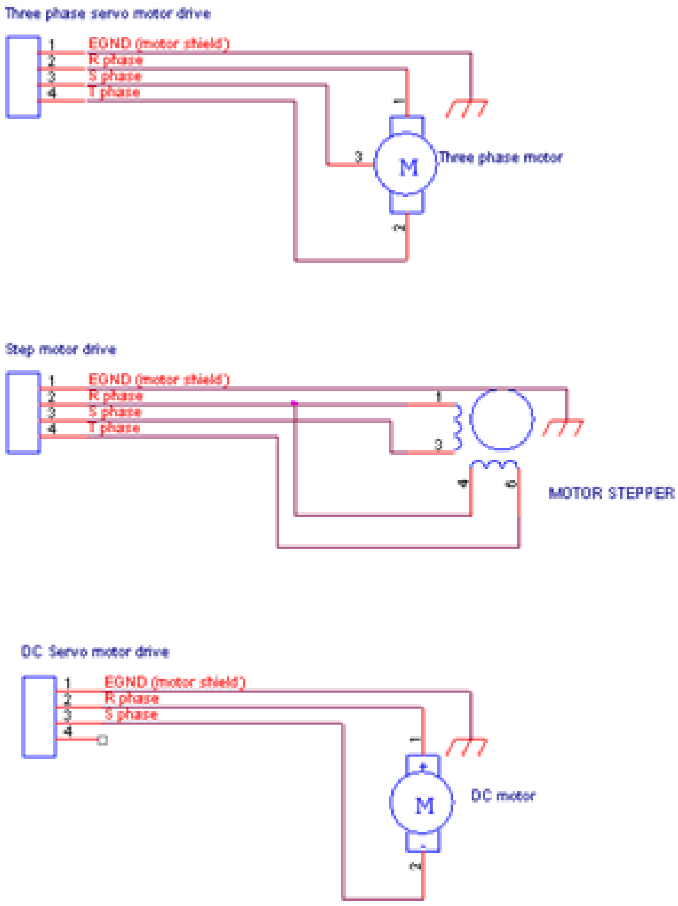


Figure 4-21. MB5U-YYYY Motor Drive Connections

4.2.7.15 MB5U-YYYY Jumper Configuration

This section details the settings of the MB5U-YYYY jumpers.

Only a qualified technician should make any changes to the factory settings of the jumpers. Remove the back cover of the unit to access the jumpers.

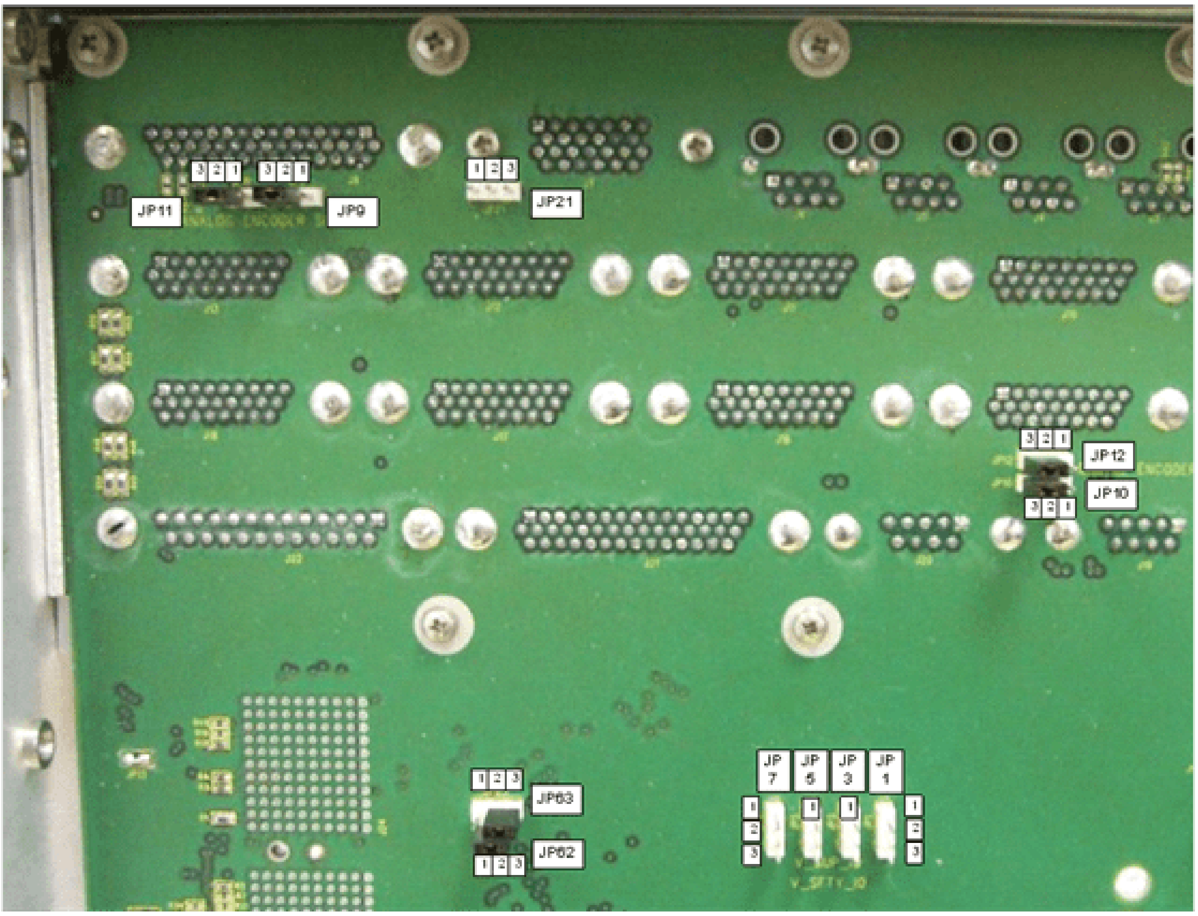


Figure 4-22. MB5U-YYYY Jumpers

Table 4-94. MB5U-YYYY Jumper Settings

Name	Description	Functionality	Use for
JP1	5/24Vdc internal Safety supply	1-2 5Vdc internal 2-3 24Vdc internal	Safety supply configuration
JP3	5/24Vdc internal I/O supply	1-2 5Vdc internal 2-3 24Vdc internal	IO supply configuration
JP5	24_RTN/ DGND IO supply return	1-2 DGND 2-3 24V_RTN	IO supply configuration
JP7	24_RTN/ DGND safety supply return	1-2 DGND	Safety supply configuration

Name	Description	Functionality	Use for
		2-3 24V_RTN	
JP9	Internal or external analog encoder supply	1-2 External 2-3 Internal	Encoder supply
JP10	Internal or external digital encoder supply	1-2 External 2-3 Internal	Encoder supply
JP11	Internal or external analog encoder supply return	1-2 External 2-3 Internal (AGND)	Encoder supply
JP21	Encoder external supply return common ground	1-2 encoder external supply connect to AGND 2-3 encoder external supply connect to DGND	Encoder supply
JP12	Internal or external digital encoder supply return	1-2 External 2-3 Internal (DGND)	Encoder supply
JP13	Digital ground to shield connection	Install – galvanic connection between digital ground to shield	Internal use only
JP14	Digital ground to analog ground connection	Install – galvanic connection between digital ground to analog ground	Internal use only

Table 4-95. I/O Jumper Setup

Setup	JP1	JP3	JP5	JP7
I/O supply external	N/A	Remove	Remove	N/A
I/O supply internal 5V	N/A	1-2	1-2	N/A
I/O supply internal 24V	N/A	2-3	2-3	N/A
Safety supply external	Remove	N/A	N/A	Remove

Safety supply internal 5V	1-2	N/A	N/A	1-2
Safety supply internal 24V	2-3	N/A	N/A	2-3

If an internal power supply is used for safety or I/O, do not connect an external power supply to the V_SUP_SFTY/V_RTN_SFTY of the Encoder connectors or the OUT of the Digital Output connectors.

Table 4-96. Encoder Supply

Setup	JP9	JP10	JP11	JP12	JP21
Analog encoder external supply	1-2	N/A	1-2	N/A	1-2
Analog encoder internal supply	2-3	N/A	2-3	N/A	Open
Digital encoder external supply	N/A	1-2	N/A	1-2	2-3
Digital encoder internal supply	N/A	2-3	N/A	2-3	Open

When using 5V internal supply for digital I/O or Safety, these I/Os will not be isolated.

Table 4-97. Default Jumper Settings

Jumper	Setting
JP1	Open
JP3	Open
JP5	Open
JP7	Open
JP9	2-3
JP10	2-3

Jumper	Setting
JP11	2-3
JP12	2-3
JP21	2-3

4.3 Individual Motherboards

4.3.1 Controller and Power Supply

4.3.1.1 MB5U-CONT-PS

The MB5U-CONT-PS is installed in the MC4U-19-Piano-enc and MC4U-22-Piano-enc.

The connectors associated with the MB5U-CONT-PS are shown in the following figure:

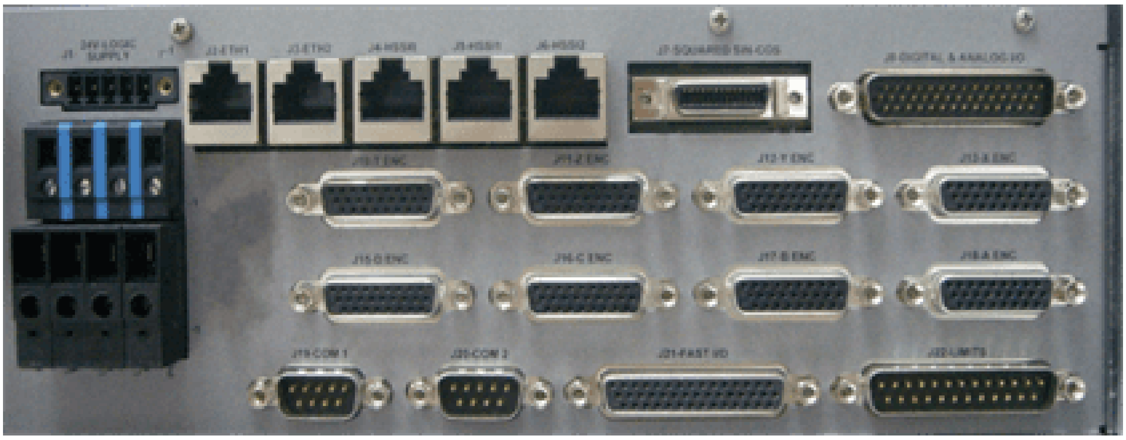


Figure 4-23. MB5U-CONT-PS Connectors

4.3.1.1.1 MB5U-CONT-PS Functionality

The MB5U-CONT-PS accommodates any SPiiPlus motion controller and the power supplies. It supports the following functionality:

- 8 x Digital encoders
- 8 x SIN-COS encoders (optional)
- 8 x Hall effect sensors
- 8 x Motor Temperature sensors
- 16 x Safety inputs
- 1 x E-stop
- 1 x Squared SIN-COS signals for axes X(0), A(2), Y(1), B(3)
- 8 x Digital outputs/Mechanical brakes
- 8 x Digital inputs
- 4 x Analog I/O

- 5 x MARK signals
- 4 x PEG signals, plus 3 x STATE signals
- 2 x Ethernet channels
- 3 x HSSI channels
- 2 x RS-232 channels

4.3.1.1.2 Encoder and Hall Connectors

Label	J10-T(5) ENC J11-Z(4) ENC J12-Y(1) ENC J13-X(0) ENC J15-D(7) ENC J16-C(6) ENC J17-B(3) ENC J18-A(2) ENC
Connector Type	D-type 26-pin HD female
Mating Type	D-type 26-pin HD male (for easy prototyping a Phoenix FLKM HDSUB-26/M Sub-D to Screw Terminal converter can be used)

The connectors are allocated as follows:

Connector	Axis	Connector	Axis
J10 - T ENC	T(5)	J15 - D ENC	D(7)
J11 - Z ENC	Z(4)	J16 - C ENC	C(6)
J12 - Y ENC	Y(1)	J17 - B ENC	B(3)
J13 - X ENC	X(0)	J18 - A ENC	A(2)

The pinout for the Encoder/Hall Connectors is given in the following table:

The dollar sign ($) stands for the given axis, for example, $_LL can be X_LL, Y_LL, etc.

Table 4-98. Encoder/Hall Pinout

Pin	Signal Designator	Description
1	$_CHA-	Encoder A(2) inverted input
2	$_CHB-	Encoder B(3) inverted input
3	$_CHI-	Encoder index inverted input
4	$_HB	Motor Hall B
5	V_SUP_SFTY	Supply for the limits input
6	$_RL	Right limit
7	$_SIN-	Encoder SIN inverted input
8	$_COS-	Encoder COS inverted input
9	$_SC_I-	Encoder SIN-COS Index inverted input
10	$_CHA+	Encoder A(2) non-inverted input
11	$_CHB+	Encoder B(3) non-inverted input
12	$_CHI+	Encoder Index non-inverted input
13	$_HA	Motor Hall A
14	$_HC	Motor Hall C
15	$_LL	Left limit
16	$_SIN+	SIN non-inverted input
17	$_COS+	Encoder COS non-inverted input
18	$_SC_I+	Encoder SIN-COS Index non-inverted input
19	5U	5V user supply for the digital encoder and Hall
20	5U_RTN	5V return user supply for the digital encoder and Hall

Pin	Signal Designator	Description
21	Shield	Shield
22	$_MTMP	Motor temperature sensor input
23	V_RTN_IO	A return for the Motor temperature sensor
24	V_RTN_SFTY	A return for the limits input
25	5F	5V user supply for the analog encoder and Hall
26	5F_RTN	5V return user supply for the analog encoder and Hall

4.3.1.1.3 J7 - Squared SIN-COS Connector

Label	J7 - SQUARED SIN-COS
Connector Type	3M, 10226-6212PC Mini D Ribbon (MDR), 26-pin female
Mating Type	3M, 10126-3000-PE Mini D Ribbon (MDR), 26-pin male

The pinout for J7 is given in the following table:

Table 4-99. J7 - Squared Sin-Cos Pinout

Pin #	Signal Designator	Description
1	X_CHA+	X(0) Channel A(2) non-inverted digital encoder output
2	X_CHA-	X(0) Channel A(2) inverted digital encoder output
3	X_CHB+	X(0) Channel B(3) non-inverted digital encoder output
4	X_CHB-	X(0) Channel B(3) inverted digital encoder output
5	X_CHI+	Not Used
6	X_CHI-	Not Used
7	A_CHA+	Not Used
8	A_CHA-	Not Used
9	A_CHB+	Not Used
10	A_CHB-	Not Used
11	A_CHI+	Not Used

Pin #	Signal Designator	Description
12	A_CHI-	Not Used
13	DGND	Internal digital supply return
14	Y_CHA+	Y(1) Channel A(2) non-inverted digital encoder output
15	Y_CHA-	Y(1) Channel A(2) inverted digital encoder output
16	Y_CHB+	Y(1) Channel B(3) non-inverted digital encoder output
17	Y_CHB-	Y(1) Channel B(3) inverted digital encoder output
18	Y_CHI+	Not Used
19	Y_CHI-	Not Used
20	B_CHA-	Not Used
21	B_CHB+	Not Used
22	B_CHB-	Not Used
23	B_CHI+	Not Used
24	B_CHI-	Not Used
25	B_CHA-	Not Used
26	-	Not connected

4.3.1.1.4 J8 - Digital and Analog I/O Connector for 12V

Label	J8 - DIGITAL & ANALOG I/O
Connector Type	D-type 44-pin HD male
Mating Type	D-type 44-pin HD female (for easy prototyping a Phoenix FLKM HDSUB-44/M Sub-D to Screw Terminal converter can be used)

J8 serves for controlling Digital and Analog I/O signal formats. The pinout for J8 is given in the following table:

Table 4-100. J8 - Digital and Analog I/O Pinout

J8 - Digital and Analog I/O Pinout

Pin #	Signal Designator	Description
1	OUT1	Digital Output 1
2	OUT3	Digital Output 3
3	OUT5	Digital Output 5
4	OUT7	Digital Output 7
5	IN1	Digital Input 1
6	IN3	Digital Input 3
7	AGND	Analog ground
8	AIN10-	Analog input AIN10 inverted
9	AIN11-	Analog input AIN11 inverted
10	AIN14-	Analog input AIN14 inverted
11	AIN15-	Analog input AIN15 inverted
12	AOUT10-	Analog output AOUT10 inverted
13	AOUT11-	Analog output AOUT11 inverted
14	AOUT14-	Analog output AOUT14 inverted
15	AOUT15-	Analog output AOUT15 inverted
16	OUT0	Digital Output 0
17	OUT2	Digital Output 2
18	OUT4	Digital Output 4
19	OUT6	Digital Output 6
20	IN0	Digital Input 0
21	IN2	Digital Input 2
22	-	Not connected

Pin #	Signal Designator	Description
23	AIN10+	Analog input AIN10 non-inverted
24	AIN11+	Analog input AIN11 non-inverted
25	AIN14+	Analog input AIN14 non-inverted
26	AIN15+	Analog input AIN15 non-inverted
27	AOUT10+ (AOUT2+)	Analog output AOUT10 non-inverted
28	AOUT11+ (AOUT6+)	Analog output AOUT11 non-inverted
29	AOUT14+ (AOUT10+)	Analog output AOUT14 non-inverted
30	AOUT15+ (AOUT14+)	Analog output AOUT15 non-inverted
31	V_SUP_IO	Input/Output Supply+
32	V_RTN_IO	Input/Output Supply Return
33	IN4/Z_MARK2	Digital Input 4 (can also be used for Z_MARK2)
34	IN5/T_MARK2	Digital Input 5 (can also be used for T_MARK2)
35	IN6/X_MARK2	Digital Input 6 (can also be used for X_MARK2)
36	IN7/Y_MARK2	Digital Input 7 (can also be used for Y_MARK2)

When employing IN4, IN5, IN6 and/or IN7 for MARK2, the normal delay for Digital Input (< 0.3 μSec) increases to 50 μSec.

Pin #	Signal Designator	Description
37	AGND	Analog ground
38	AGND	Analog ground

Pin #	Signal Designator	Description
39	-	Not connected
40	-	Not connected
41	-	Not connected
42	+12V1	12V for joystick (optional, need 0Ω resistor)
43	12V1_RTN	+-12V return for joystick (optional, need 0Ω resistor)
44	-12V1	-12V for joystick (optional, need 0Ω resistor)

4.3.1.1.5 J9 - Regeneration Connector

J9 is relevant only if the PSM3U-320V-XXkW (high-power supply) is being used.

Label	J9 - REGENERATION
Connector Type	Phoenix FRONT 2,5-V/SA 10
Mating Type	None (screw terminal)

The pinout for J9 is provided in the following table:

Table 4-101. J9 - Regeneration Pinout

Pin #	Signal Designator	Description
1	REG1_1	Regeneration resistor for PS 1 (V1 on the motherboard)
2	REG1_2	Regeneration resistor for PS 1
3	REG2_1	Regeneration resistor for PS 2 (V2 on the motherboard)
4	REG2_2	Regeneration resistor for PS 2

4.3.1.1.6 J21 - Fast I/O (PEG and Mark) Connector

Label	J21 - FAST I/O
Connector Type	D-type 44-pin HD female connector.
Mating Type	D-type 44-pin HD male (for easy prototyping a Phoenix FLKM HDSUB-44/M Sub-D to Screw Terminal converter can be used)

The pinout for J21 is given in the following table:

Table 4-102. J21 - PEG and Mark Fast I/O Pinout

Pin #	Signal Designator	Description
1	-	Not connected
2	-	Not connected
3	-	Not connected
4	X_STATE2+	State Digital output non-inverted
5	X_STATE1+	State Digital output non-inverted
6	X_STATE0+	State Digital output non-inverted
7	-	Not connected
8	-	Not connected
9	DGND	Internal digital supply return
10	DGND	Internal digital supply return
11	T_PEG+	PEG Digital output non-inverted
12	Z_PEG+	PEG Digital output non-inverted
13	Y_PEG+	PEG Digital output non-inverted
14	X_PEG+	PEG Digital output non-inverted
15	-	Not connected.
16	-	Not connected
17	-	Not connected

Pin #	Signal Designator	Description
18	-	Not connected
19	X_STATE2-	State Digital output inverted
20	X_STATE1-	State Digital output inverted
21	X_STATE0-	State Digital output inverted
22	-	Not connected
23	-	Not connected
24	-	Not connected
25	-	Not connected
26	T_PEG-	PEG Digital output inverted
27	Z_PEG-	PEG Digital output inverted
28	Y_PEG-	PEG Digital output inverted
29	X_PEG-	PEG Digital output inverted
30	-	Not connected
31	X_MARK1+	Mark Digital input non-inverted
32	X_MARK1-	Mark Digital input inverted
33	-	Not connected
34	-	Not connected
35	Y_MARK1+	Mark Digital input non-inverted
36	Y_MARK1-	Mark Digital input inverted
37	-	Not connected
38	-	Not connected
39	Z_MARK1+	Mark Digital input non-inverted
40	Z_MARK1-	Mark Digital input inverted
41	-	Not connected

Pin #	Signal Designator	Description
42	-	Not connected
43	T_MARK1+	Mark Digital input non-inverted
44	T_MARK1-	Mark Digital input inverted

4.3.1.1.7 J22 - Motor Limits Connector

Label	J22 - LIMITS
Connector Type	D-type 25-pin male
Mating Type	D-type 25-pin female (for easy prototyping a Phoenix FLKM HDSUB-25/M Sub-D to Screw Terminal converter can be used)

The pinout for J22 is given in the following table:

Pin #	Signal Designator	Description
1	V_SUP_SFTY	Safety Supply +
2	-	Not connected
3	X_LL	X(0) Left Limit
4	A_LL	A(2) Left Limit
5	Y_LL	Y(1) Left Limit
6	B_LL	B(3) Left Limit
7	Z_LL	Z(4) Left Limit
8	C_LL	C(6) Left Limit
9	T_LL	T(5) Left Limit
10	D_LL	D(7) Left Limit
11	-	Not connected
12	-	Not connected
13	-	Not connected

Pin #	Signal Designator	Description
14	V_RTN_SFTY	Safety Supply Return
15	-	Not connected
16	X_RL	X(0) Right Limit
17	A_RL	A(2) Right Limit
18	Y_RL	Y(1) Right Limit
19	B_RL	B(3) Right Limit
20	Z_RL	Z(4) Right Limit
21	C_RL	C(6) Right Limit
22	T_RL	T(6) Right Limit
23	D_RL	D(7) Right Limit
24	ES+	Emergency stop non-inverted
25	ES-	Emergency stop inverted

4.3.1.1.8 J4, J5, and J6 - HSSI Connectors

Label	J4 - HSSI0 (X(0) & A(2) axes)
	J5 - HSSI1 (Y(1) & B(3) axes)
	J6 - HSSI2 (Z(4) & C(6) axes)
Connector Type	RJ45 8-pin sockets
Mating Type	RJ45 8-pin plug

The pinout of the sockets is given in the following table:

Pin #	Signal Designator	Description
1	CONTROL_$+	Control signal non-inverted output for channel 0
2	CONTROL_$-	Control signal inverted output for channel 0
3	SER_DI_$+	Serial data non-inverted input for channel 0
4	SER_DI_$-	Serial data inverted input for channel 0

Pin #	Signal Designator	Description
5	SER_DO_$+	Serial data non-inverted output for channel 0
6	SER_DO_$-	Serial data inverted output for channel 0
7	DGND	Digital ground for 5L
8	DGND	Digital ground for 5L

4.3.1.1.9 J2 and J3 - Ethernet Connectors

Label	J2 - ETH1
	J3 - ETH2
Connector Type	RJ45 8-pin socket
Mating Type	RJ45 8-pin plug

The pinout of the sockets is given in the following table:

Table 4-103. J2 and J3 - Ethernet Pinout

Pin #	Signal Designator	Description
1	ETH$_TX+	Positive transmit signal
2	ETH$_TX -	Negative transmit signal
3	ETH$_RX +	Positive receive signal
4	-	Not connected
5	-	Not connected
6	ETH$_RX -	Negative receive signal
7	-	Not connected
8	-	Not connected

4.3.1.1.10 J19 and J20 RS-232 Communication Connectors

Label	J19 - COM1
	J20 - COM2
Connector Type	D-type 9-pin male sockets

Mating type	D-type 9-pin female

When necessary, use COM2 to run the MMI Application Studio Upgrade and Recovery Wizard Recovery Task (see the MMI Application Studio User Guide for details).

The pinout for the sockets is given in the following table:

Table 4-104. J19 and J20 - RS-232 Communication Pinout

Pin #	Signal Designator	Description
1	SHIELD	Cable shield connection
2	RX232	RS-232 receive signal for the communication port (J19 for COM1, and J20 for COM2)
3	TX232	RS-232 transmit signal for communication port (J19 for COM1, and J20 for COM2).
4	-	Not connected
5	DGND	Digital ground.
6	-	Not connected
7	-	Not connected
8	-	Not connected
9	-	Not connected

4.3.1.1.11 J14 - Drive Supply Voltage Connector

Label	J14 - DRIVE SUPPLY
Connector Type	Phoenix FRONT 4V-7,62
Mating Type	None (screw terminal)

AC power is provided through J14. The pinout for J14 is provided in the following table:

Table 4-105. J14 - Drive Supply Voltage Pinout

Pin #	Signal Designator	Description	Remarks
1	EGND	Earth Ground (shield)	
2	L3	AC input phase L3	
3	L2	AC input phase L2	When using AC single-phase, the voltage has to be connected between L1 and L2.
4	L1	AC input phase L1	

4.3.1.1.12 J1 - 24V Logic Supply Connector

Label	J1 - 24V LOGIC SUPPLY
Connector Type	Phoenix MCV-1.5/5 GF 3.81
Mating Type	Phoenix MC-1.5/5 STF- 3.81

24Vdc is provided through J1. The J1 pinout is provided in the following table:

Table 4-106. J1 - 24V Logic Supply Pinout

Pin #	Signal Designator	Description
1	24V_SUP	24V logic supply
2	24V_RTN	24V logic supply return
3	5V_ENC_EXT	External 5V supply for encoder
4	5V_ENC_EXT_RTN	External 5V supply return for encoder
5	EGND	Electrical Ground

4.3.1.1.13 MB5U-CONT-PS Jumpers

This section details the settings of the MB5U-CONT-PS jumpers.

Only a qualified technician should make any changes to the factory settings of the jumpers. Remove the back cover of the unit to access the jumpers.

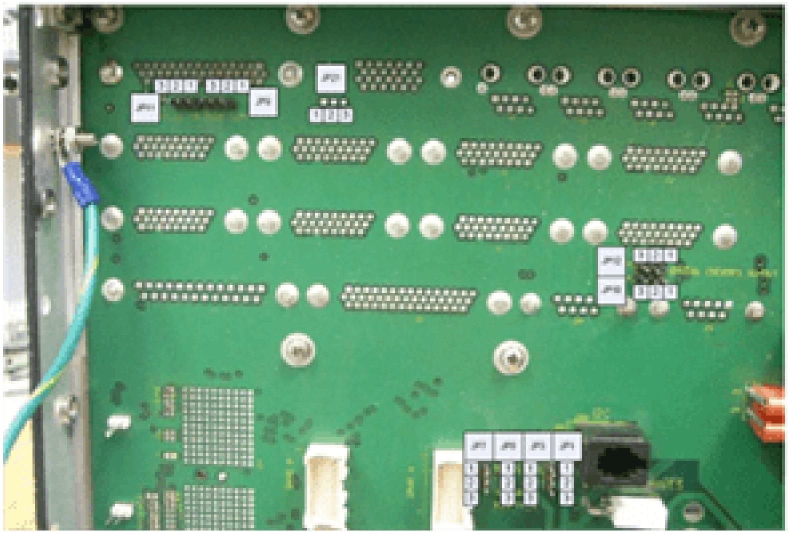


Figure 4-24. MB5U-CONT-PS Jumpers and Pin Numbers

Table 4-107. I/O Jumpers

Setup	JP1	JP3	JP5	JP7
I/O supply external	N/A	Remove	Remove	N/A
I/O supply internal 5V	N/A	1-2	1-2	N/A
I/O supply internal 24V	N/A	2-3	2-3	N/A
Safety supply eN/Aternal	Remove	N/A	N/A	Remove
Safety supply internal 5V	1-2	N/A	N/A	1-2
Safety supply internal 24V	2-3	N/A	N/A	2-3

If an internal power supply is used for safety or I/O, do not connect an external power supply to the V_SUP_SFTY/V_RTN_SFTY of the Encoder connectors or the OUT of the Digital Output connectors.

When using the 5V internal supply for digital I/O or Safety, these I/Os are not isolated.

Table 4-108. Encoder Supply

Setup	JP9	JP10	JP11	JP12	JP21
Analog encoder external supply	1-2	N/A	1-2	N/A	1-2
Analog encoder internal supply	2-3	N/A	2-3	N/A	Open
Digital encoder external supply	N/A	1-2	N/A	1-2	2-3
Digital encoder internal supply	N/A	2-3	N/A	2-3	Open

Table 4-109. Default Jumper Settings

Jumper	Setting
JP1	Open
JP3	Open
JP5	Open
JP7	Open
JP9	2-3
JP10	2-3
JP11	2-3
JP12	2-3
JP21	2-3

Table 4-110. I^{2}C Address

Setup	JP15	JP16	JP18	JP19
Address 5, 6 for power supplies	Open	Installed	Installed	Open

The general purpose analog inputs are shared with the IS current feedback; therefore the jumpers must be set as given in the table below.

Table 4-111. General Purpose Analog Input Jumpers

Setup	JP22, JP28	JP23, JP29	JP24, JP25	JP26, JP27
When Z axis integrated drive is used, there is no AIN10 support	Remove	N/A	N/A	N/A
When C axis integrated drive is used, there is no AIN11 support	N/A	Remove	N/A	N/A
When T axis integrated drive is used, there is no AIN14 support	N/A	N/A	Remove	N/A
When D axis integrated drive is used, there is no AIN15 support	N/A	N/A	N/A	Remove

4.3.1.2 MB5U-CONT-PS2

The MB5U-CONT-PS2 is installed in the MC4U-19-enc and MC4U-22-Piano-enc.

The connectors associated with the MB5U-CONT-PS2 motherboard are shown in the following figure:

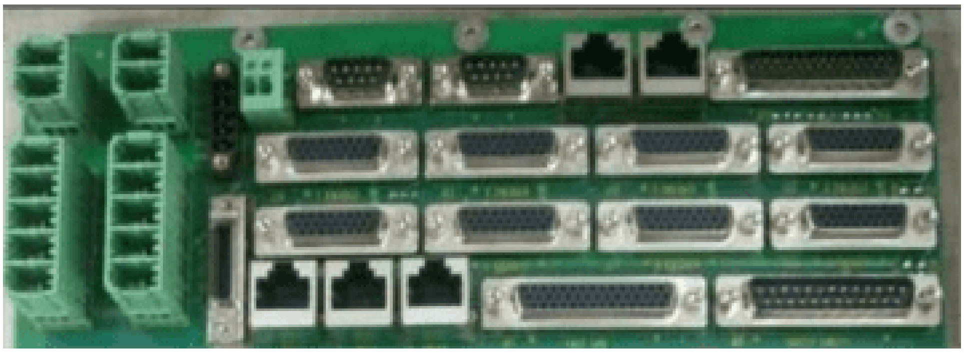


Figure 4-25. MB5U-CONT-PS2 Connectors

4.3.1.2.1 MB5U-CONT-PS2 Functionality

The MB5U-CONT-PS2 accommodates any SPiiPlus motion controller and the power supplies. It supports the following functionality:

- 8 x Digital encoders
- 8 x SIN-COS encoders (optional)
- 8 x Hall effect sensors
- 8 x Motor Temperature sensors
- 16 x Safety inputs
- 1 x E-stop
- 1 x Squared SIN-COS signals for axes 0(X), 2(A), 1(Y), 3(B)
- 8 x Digital outputs/Mechanical brakes
- 8 x Digital inputs
- 4 x Analog I/O
- 5 x MARK signals
- 4 x PEG signals, plus 3 x STATE signals
- 2 x Ethernet channels
- 3 x HSSI channels
- 2 x RS-232 channels

4.3.1.2.2 J1 - 24V Logic Supply Connector

Label	J1 - 24V LOGIC SUPPLY
Connector Type	Phoenix MCV-1.5/5 GF 3.81
Mating Type	Phoenix MC-1.5/5 STF- 3.81

24Vdc is provided through J1. The J1 pinout is provided in the following table:

Table 4-112. J1 - 24V Logic Supply Pinout

Pin #	Signal Designator	Description
1	24V_SUP	24V logic supply
2	24V_RTN	24V logic supply return
3	5V_ENC_EXT	External 5V supply for encoder
4	5V_ENC_EXT_RTN	External 5V supply return for encoder
5	EGND	Electrical Ground

4.3.1.2.3 *Encoder and Hall Connectors*

Label	J10-T(5) ENC
	J11-Z(4) ENC
	J12-Y(1) ENC
	J13-X(0) ENC
	J15-D(7) ENC
	J16-C(6) ENC
	J17-B(3) ENC
	J18-A(2) ENC
Connector Type	D-type 26-pin HD female
Mating Type	Neltron 5508-26P-01-F1

The connectors are allocated as follows:

Connector	Axis	Connector	Axis
J10 - T ENC	T(5)	J15 - D ENC	D(7)
J11 - Z ENC	Z(4)	J16 - C ENC	C(6)
J12 - Y ENC	Y(1)	J17 - B ENC	B(3)
J13 - X ENC	X(0)	J18 - A ENC	A(2)

The pinout for the Encoder/Hall Connectors is given in the following table:

> The dollar sign ($) stands for the given axis, for example, $_LL can be X_LL, Y_LL, etc.

Table 4-113. Encoder/Hall Pinout

Pin	Signal Designator	Description
1	$_CHA-	Encoder A(2) inverted input
2	$_CHB-	Encoder B(3) inverted input
3	$_CHI-	Encoder index inverted input

Pin	Signal Designator	Description
4	$_HB	Motor Hall B
5	V_SUP_SFTY	Supply for the limits input
6	$_RL	Right limit
7	$_SIN-	Encoder SIN inverted input
8	$_COS-	Encoder COS inverted input
9	$_SC_I-	Encoder SIN-COS Index inverted input
10	$_CHA+	Encoder A(2) non-inverted input
11	$_CHB+	Encoder B(3) non-inverted input
12	$_CHI+	Encoder Index non-inverted input
13	$_HA	Motor Hall A
14	$_HC	Motor Hall C
15	$_LL	Left limit
16	$_SIN+	SIN non-inverted input
17	$_COS+	Encoder COS non-inverted input
18	$_SC_I+	Encoder SIN-COS Index non-inverted input
19	5U	5V user supply for the digital encoder and Hall
20	5U_RTN	5V return user supply for the digital encoder and Hall
21	Shield	Shield
22	$_MTMP	Motor temperature sensor input
23	V_RTN_IO	A return for the Motor temperature sensor
24	V_RTN_SFTY	A return for the limits input
25	5F	5V user supply for the analog encoder and Hall
26	5F_RTN	5V return user supply for the analog encoder and Hall

4.3.1.2.4 J7 - Squared SIN-COS Connector

Label	J7 - SQUARED SIN-COS
Connector Type	3M, 10226-6212PC Mini D Ribbon (MDR), 26-pin female
Mating Type	3M, 10126-3000-PE Mini D Ribbon (MDR), 26-pin male

The pinout for J7 is given in the following table:

Table 4-114. J7 - Squared Sin-Cos Pinout

Pin #	Signal Designator	Description
1	X_CHA+	X(0) Channel A(2) non-inverted digital encoder output
2	X_CHA-	X(0) Channel A(2) inverted digital encoder output
3	X_CHB+	X(0) Channel B(3) non-inverted digital encoder output
4	X_CHB-	X(0) Channel B(3) inverted digital encoder output
5	X_CHI+	Not Used
6	X_CHI-	Not Used
7	A_CHA+	Not Used
8	A_CHA-	Not Used
9	A_CHB+	Not Used
10	A_CHB-	Not Used
11	A_CHI+	Not Used
12	A_CHI-	Not Used
13	DGND	Internal digital supply return
14	Y_CHA+	Y(1) Channel A(2) non-inverted digital encoder output
15	Y_CHA-	Y(1) Channel A(2) inverted digital encoder output
16	Y_CHB+	Y(1) Channel B(3) non-inverted digital encoder output
17	Y_CHB-	Y(1) Channel B(3) inverted digital encoder output
18	Y_CHI+	Not Used

Pin #	Signal Designator	Description
19	Y_CHI-	Not Used
20	B_CHA-	Not Used
21	B_CHB+	Not Used
22	B_CHB-	Not Used
23	B_CHI+	Not Used
24	B_CHI-	Not Used
25	B_CHA-	Not Used
26	-	Not connected

4.3.1.2.5 J8 - Digital and Analog I/O Connector for 12V

Label	J8 - DIGITAL & ANALOG I/O
Connector Type	D-type 44-pin HD male
Mating Type	D-type 44-pin HD female (for easy prototyping a Phoenix FLKM HDSUB-44/M Sub-D to Screw Terminal converter can be used)

J8 serves for controlling Digital and Analog I/O signal formats. The pinout for J8 is given in the following table:

Table 4-115. J8 - Digital and Analog I/O Pinout

J8 - Digital and Analog I/O Pinout

Pin #	Signal Designator	Description
1	OUT1	Digital Output 1
2	OUT3	Digital Output 3
3	OUT5	Digital Output 5
4	OUT7	Digital Output 7
5	IN1	Digital Input 1
6	IN3	Digital Input 3

Pin #	Signal Designator	Description
7	AGND	Analog ground
8	AIN10-	Analog input AIN10 inverted
9	AIN11-	Analog input AIN11 inverted
10	AIN14-	Analog input AIN14 inverted
11	AIN15-	Analog input AIN15 inverted
12	AOUT10-	Analog output AOUT10 inverted
13	AOUT11-	Analog output AOUT11 inverted
14	AOUT14-	Analog output AOUT14 inverted
15	AOUT15-	Analog output AOUT15 inverted
16	OUT0	Digital Output 0
17	OUT2	Digital Output 2
18	OUT4	Digital Output 4
19	OUT6	Digital Output 6
20	IN0	Digital Input 0
21	IN2	Digital Input 2
22	-	Not connected
23	AIN10+	Analog input AIN10 non-inverted
24	AIN11+	Analog input AIN11 non-inverted
25	AIN14+	Analog input AIN14 non-inverted
26	AIN15+	Analog input AIN15 non-inverted
27	AOUT10+ (AOUT2+)	Analog output AOUT10 non-inverted
28	AOUT11+ (AOUT6+)	Analog output AOUT11 non-inverted

Pin #	Signal Designator	Description
29	AOUT14+ (AOUT10+)	Analog output AOUT14 non-inverted
30	AOUT15+ (AOUT14+)	Analog output AOUT15 non-inverted
31	V_SUP_IO	Input/Output Supply+
32	V_RTN_IO	Input/Output Supply Return
33	IN4/Z_MARK2	Digital Input 4 (can also be used for Z_MARK2)
34	IN5/T_MARK2	Digital Input 5 (can also be used for T_MARK2)
35	IN6/X_MARK2	Digital Input 6 (can also be used for X_MARK2)
36	IN7/Y_MARK2	Digital Input 7 (can also be used for Y_MARK2)
When employing IN4, IN5, IN6 and/or IN7 for MARK2, the normal delay for Digital Input (< 0.3 μSec) increases to 50 μSec.		
37	AGND	Analog ground
38	AGND	Analog ground
39	-	Not connected
40	-	Not connected
41	-	Not connected
42	+12V1	+12V for joystick (not in use)
43	12V1_RTN	12V return for joystick (not in use)
44	-12V1	-12V for joystick (not in use)

4.3.1.2.6 J14, J114 - Drive Supply Voltage Connector

Label	J14 - DRIVE SUPPLY 1
	J114 - DRIVE SUPPLY 2
Connector Type	Phoenix PCV 5/ 5-G-7,62 5-pin header pitch 7.62mm
Mating Type	Phoenix PC 5/ 5-STCL1-7,62 5-pin plug with lockers pitch 7.62mm UL508C 41A, 600V

AC power is provided through J14 and J114. The pinout for J14 and J114 is provided in the following table:

Table 4-116. J14, J114 - Drive Supply Voltage Pinout

Pin #	Signal Designator	Description	Remarks
1	L$_1	AC input phase L1	
2	L$_2	AC input phase L2	
3	L$_3	AC input phase L3	When using AC single-phase, the voltage has to be connected between L1 and L2.
4	--	Not connected	
5	EGND	Earth Ground (shield)	

4.3.1.2.7 J21 - Fast I/O (PEG and Mark) Connector

Label	J21 - FAST I/O
Connector Type	D-type 44-pin HD female connector.
Mating Type	D-type 44-pin HD male (for easy prototyping a Phoenix FLKM HDSUB-44/M Sub-D to Screw Terminal converter can be used)

The pinout for J21 is given in the following table:

Table 4-117. J21 - PEG and Mark Fast I/O Pinout

Pin #	Signal Designator	Description
1	-	Not connected
2	-	Not connected
3	-	Not connected
4	X_STATE2+	State Digital output non-inverted
5	X_STATE1+	State Digital output non-inverted
6	X_STATE0+	State Digital output non-inverted
7	-	Not connected
8	-	Not connected
9	DGND	Internal digital supply return
10	DGND	Internal digital supply return
11	T_PEG+	PEG Digital output non-inverted
12	Z_PEG+	PEG Digital output non-inverted
13	Y_PEG+	PEG Digital output non-inverted
14	X_PEG+	PEG Digital output non-inverted
15	-	Not connected.
16	-	Not connected
17	-	Not connected
18	-	Not connected
19	X_STATE2-	State Digital output inverted
20	X_STATE1-	State Digital output inverted
21	X_STATE0-	State Digital output inverted
22	-	Not connected
23	-	Not connected

Pin #	Signal Designator	Description
24	-	Not connected
25	-	Not connected
26	T_PEG-	PEG Digital output inverted
27	Z_PEG-	PEG Digital output inverted
28	Y_PEG-	PEG Digital output inverted
29	X_PEG-	PEG Digital output inverted
30	-	Not connected
31	X_MARK1+	Mark Digital input non-inverted
32	X_MARK1-	Mark Digital input inverted
33	-	Not connected
34	-	Not connected
35	Y_MARK1+	Mark Digital input non-inverted
36	Y_MARK1-	Mark Digital input inverted
37	-	Not connected
38	-	Not connected
39	Z_MARK1+	Mark Digital input non-inverted
40	Z_MARK1-	Mark Digital input inverted
41	-	Not connected
42	-	Not connected
43	T_MARK1+	Mark Digital input non-inverted
44	T_MARK1-	Mark Digital input inverted

4.3.1.2.8 J22 - Motor Limits Connector

Label	J22 - LIMITS
Connector Type	D-type 25-pin male
Mating Type	D-type 25-pin female (for easy prototyping a Phoenix FLKM HDSUB-25/M Sub-D to Screw Terminal converter can be used)

The pinout for J22 is given in the following table:

Table 4-118. J22 - Motor Limits Pinout

Pin #	Signal Designator	Description
1	V_SUP_SFTY	Safety Supply +
2	-	Not connected
3	X_LL	X(0) Left Limit
4	A_LL	A(2) Left Limit
5	Y_LL	Y(1) Left Limit
6	B_LL	B(3) Left Limit
7	Z_LL	Z(4) Left Limit
8	C_LL	C(6) Left Limit
9	T_LL	T(5) Left Limit
10	D_LL	D(7) Left Limit
11	-	Not connected
12	-	Not connected
13	-	Not connected
14	V_RTN_SFTY	Safety Supply Return
15	-	Not connected
16	X_RL	X(0) Right Limit
17	A_RL	A(2) Right Limit

Pin #	Signal Designator	Description
18	Y_RL	Y(1) Right Limit
19	B_RL	B(3) Right Limit
20	Z_RL	Z(4) Right Limit
21	C_RL	C(6) Right Limit
22	T_RL	T(5) Right Limit
23	D_RL	D(7) Right Limit
24	ES+	Emergency stop non-inverted
25	ES-	Emergency stop inverted

4.3.1.2.9 J4, J5, and J6 - HSSI Connectors

Label	J4 - HSSI0 (X(0) & A(2) axes)
	J5 - HSSI1 (Y(1) & B(3) axes)
	J6 - HSSI2 (Z(4) & C(6) axes)
Connector Type	RJ45 8-pin sockets
Mating Type	RJ45 8-pin plug

The pinout of the sockets is given in the following table:

Table 4-119. J4, J5, and J6 - HSSI Pinout

Pin #	Signal Designator	Description
1	CONTROL_$+	Control signal non-inverted output for channel 0
2	CONTROL_$-	Control signal inverted output for channel 0
3	SER_DI_$+	Serial data non-inverted input for channel 0
4	SER_DI_$-	Serial data inverted input for channel 0
5	SER_DO_$+	Serial data non-inverted output for channel 0
6	SER_DO_$-	Serial data inverted output for channel 0
7	DGND	Digital ground for 5L

Pin #	Signal Designator	Description
8	DGND	Digital ground for 5L

4.3.1.2.10 J2 and J3 - Ethernet Connectors

Label	J2 - ETH1 J3 - ETH2
Connector Type	RJ45 8-pin socket
Mating Type	RJ45 8-pin plug

The pinout of the sockets is given in the following table:

Table 4-120. J2 and J3 - Ethernet Pinout

Pin #	Signal Designator	Description
1	ETH$_TX+	Positive transmit signal
2	ETH$_TX -	Negative transmit signal
3	ETH$_RX +	Positive receive signal
4	-	Not connected
5	-	Not connected
6	ETH$_RX -	Negative receive signal
7	-	Not connected
8	-	Not connected

4.3.1.2.11 J19 and J20 RS-232 Communication Connectors

Label	J19 - COM1 J20 - COM2
Connector Type	D-type 9-pin male sockets
Mating type	D-type 9-pin female

When necessary, use COM2 to run the MMI Application Studio Upgrade and Recovery Wizard Recovery Task (see the MMI Application Studio User Guide for details).

The pinout for the sockets is given in the following table:

Table 4-121. J19 and J20 - RS-232 Communication Pinout

Pin #	Signal Designator	Description
1	SHIELD	Cable shield connection
2	RX232	RS-232 receive signal for the communication port (J19 for COM1, and J20 for COM2)
3	TX232	RS-232 transmit signal for communication port (J19 for COM1, and J20 for COM2).
4	-	Not connected
5	DGND	Digital ground.
6	-	Not connected
7	-	Not connected
8	-	Not connected
9	-	Not connected

4.3.1.2.12 J9, J109 - Regeneration Connector

Label	J9 - REG 1 J109 - REG 2
Connector Type	Phoenix PCV 5/ 2-G-7,62 2-pin header pitch 7.62mm UL508C 41A, 300V, UL840 41A, 630V
Mating Type	Phoenix PC 5/ 2-STCL1-7,62 2-pin plug with lockers pitch 7.62mm UL508C 41A, 600V

The pinout for J9 and J109 is provided in the following table:

Table 4-122. J9, J109 - Regeneration Pinout

J9, J109 - Regeneration Pinout

Pin #	Signal Designator	Description
1	REG$_1	Regeneration resistor pole 1
2	REG$_2	Regeneration resistor pole 2

4.3.1.2.13 J145 - 60V Drive Supply Connector

Label	J145 - 60V Drive Supply
Connector Type	Phoenix 1,5/2-V-3,81 2-pin terminal block pitch 3.81mm UL508C 10A, 300V

The pinout for J145 is provided in the following table:

Table 4-123. J145 - 60V Drive Supply Pinout

Pin #	Signal Designator	Description
+	60V_SUP	Supplies 60V to the drive
-	60V_RTN	60V return

> This connector is typically not in use. Users wishing to implement an external DC supply of up to 60V should contact ACS.

4.3.1.2.14 MB5U-CONT-PS2 Jumpers

This section details the settings of the MB5U-CONT-PS2 jumpers

> Only a qualified technician should make any changes to the factory settings of the jumpers. Remove the back cover of the unit to access the jumpers.

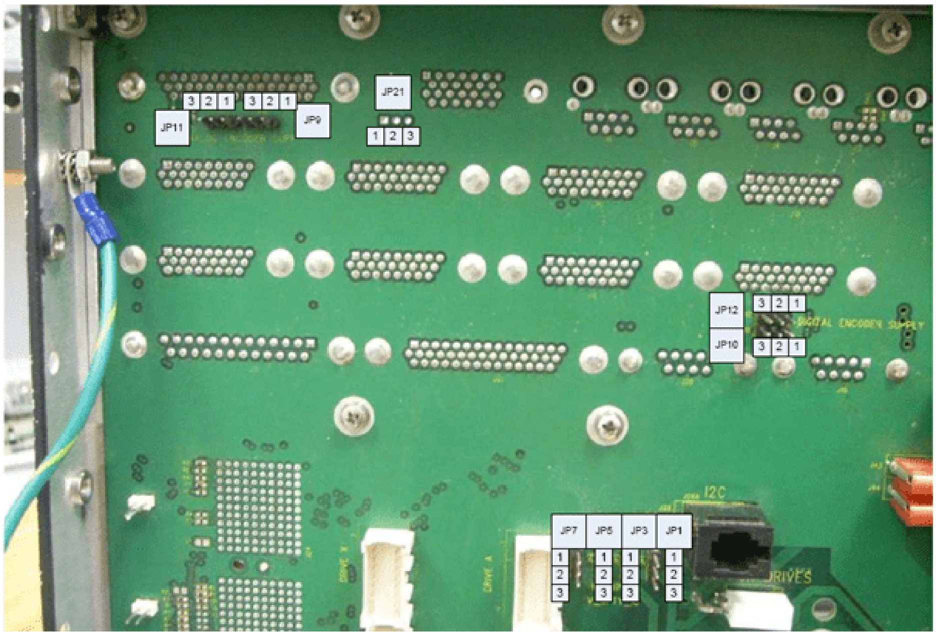


Figure 4-26. MB5U-CON-PS2 Motherboard Jumpers and Pin Numbers

Table 4-124. I/O Jumpers

Setup	JP1	JP3	JP5	JP7
I/O supply external	N/A	Remove	Remove	N/A
I/O supply internal 5V	N/A	1-2	1-2	N/A
I/O supply internal 24V	N/A	2-3	2-3	N/A
Safety supply external	Remove	N/A	N/A	Remove
Safety supply internal 5V	1-2	N/A	N/A	1-2
Safety supply internal 24V	2-3	N/A	N/A	2-3

If an internal power supply is used for safety or I/O, do not connect an external power supply to the V_SUP_SFTY/V_RTN_SFTY of the Encoder connectors or the OUT of the Digital Output connectors.

When using the 5V internal supply for digital I/O or Safety, these I/Os are not isolated.

Table 4-125. Encoder Supply

Setup	JP9	JP10	JP11	JP12	JP21
Analog encoder external supply	1-2	N/A	1-2	N/A	1-2
Analog encoder internal supply	2-3	N/A	2-3	N/A	Open
Digital encoder external supply	N/A	1-2	N/A	1-2	2-3
Digital encoder internal supply	N/A	2-3	N/A	2-3	Open

Table 4-126. I^2C Address

Setup	JP15	JP16	JP18	JP19
Address 5, 6 for power supplies	Open	Installed	Installed	Open

The general purpose analog inputs are shared with the IS current feedback; therefore the jumpers must be set as given in the table below.

Table 4-127. General Purpose Analog Input Jumpers

Setup	JP22, JP28	JP23, JP29	JP24, JP25	JP26, JP27
When Z(4) axis integrated drive is used, there is no AIN10 support	Remove	N/A	N/A	N/A
When C(6) axis integrated drive is used, there is no AIN11 support	N/A	Remove	N/A	N/A

Setup	JP22, JP28	JP23, JP29	JP24, JP25	JP26, JP27
When T(5) axis integrated drive is used, there is no AIN14 support	N/A	N/A	Remove	N/A
When D(7) axis integrated drive is used, there is no AIN15 support	N/A	N/A	N/A	Remove

4.3.2 Drive Module

4.3.2.1 MB5U-2-20

The MB5U-2-20 is installed in the MC4U-19-Piano-enc. It accommodates a DDM3U-2-320V-YY dual axis drive and includes a connector for two motors.

The connectors associated with the MB5U-2-20 are shown in the following figure:

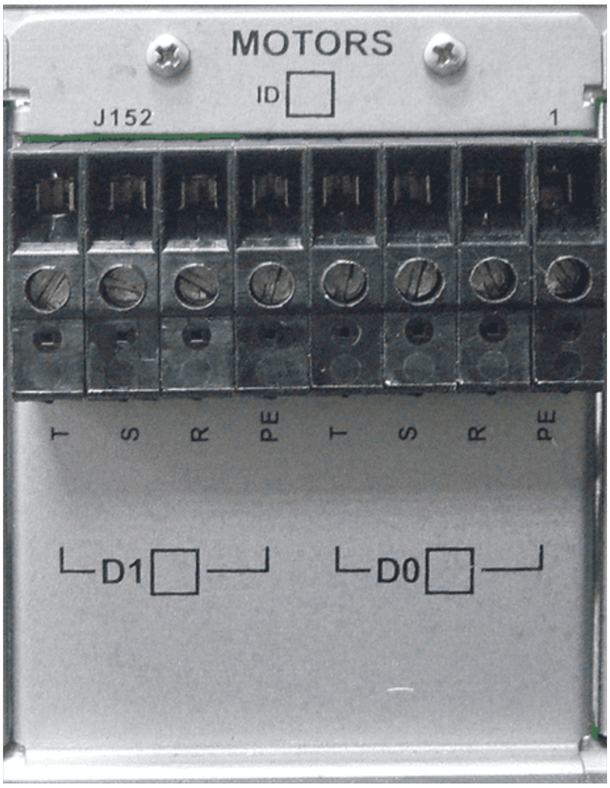


Figure 4-27. MB5U-2-20 Connectors

4.3.2.1.1 J152 - Servo Motor Drive

Label	J152
Connector Type	Phoenix FRONT 4V-7,62 connector.
Mating Type	None (terminal screw)

The pinout for J152 is given in the following table:

Table 4-128. J152 - Servo Motor Drive Pinout

Pin #	Signal Designator	Description
1	EGND	Electrical Ground
2	R_0	Motor 0 R phase
3	S_0	Motor 0 S phase
4	T_0	Motor 0 T phase
5	EGND	Electrical Ground
6	R_1	Motor 1 R phase
7	S_1	Motor 1 S phase
8	T_1	Motor 1 T phase

The following diagrams illustrate how motors are to be connected:

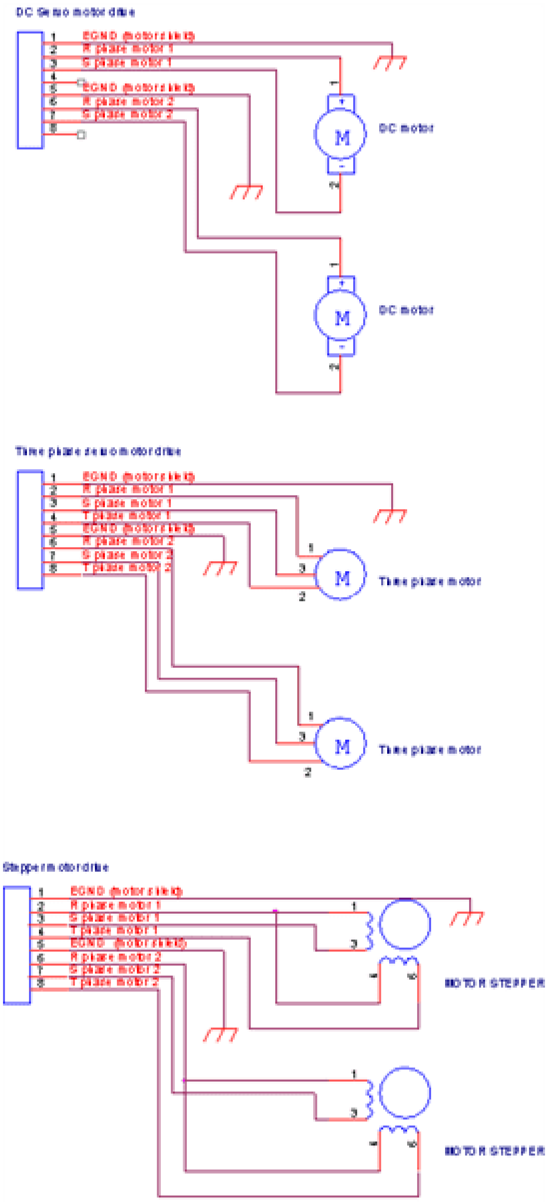


Figure 4-28. MB5U-2-20 Motor Drive Connections

4.3.2.1.2 MB5U-2-20 Jumpers

This section details the settings of the MB5U-2-20 jumpers.

> Only a qualified technician should make any changes to the factory settings of the jumpers. Remove the back cover of the unit to access the jumpers.

The following table provides details of the settings for the MB5U-2-20 jumpers.

Table 4-129. MB5U-2-20 Jumper Settings

Name	Description	Functionality
JP2, JP3,	I2C A0, A1,	Used for setting the I^2C address: Set the JP2 & JP3 to: “00” when the motherboard assembly is slot number 0. “01” when the motherboard assembly is slot number 1. “10” when the motherboard assembly is slot number 2. “11” when the motherboard assembly is slot number 3. 0 - the jumper is installed. 1 - the jumper is removed.

4.3.2.2 MB5U-2-45

The MB5U-2-45 can be installed in the MC4U-19-Piano-enc or MC4U-22-Piano-enc Control Modules.

MB5U-2-45 supports the following Drives:

> DDM3U-1-320V-XX-YY
> DDM3U-2-320V-XX
> DDM3U-2-560V-XX
> DDM3U-1-100V-15A-NP
> DDM3U-1-320V-15A-NP

The connectors associated with the MB5U-2-45 motherboard are shown in the following figure:

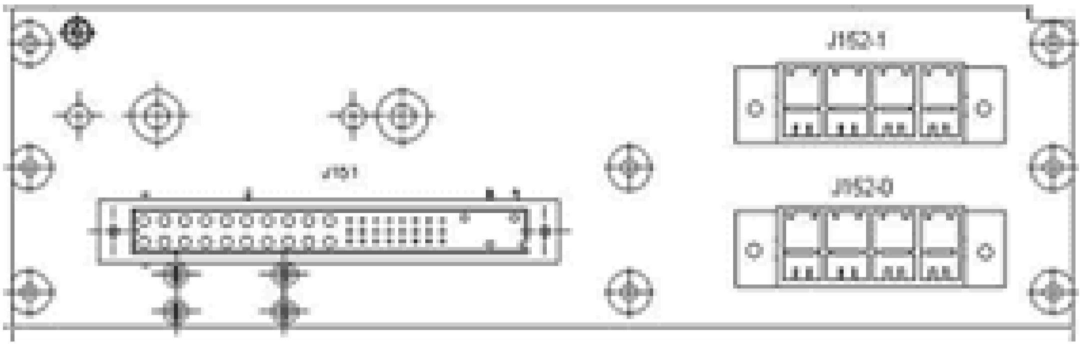


Figure 4-29. MB5U-2-45 Connectors

4.3.2.2.1 J152-0, J152-1 - Servo Motor Drive

Label	J152-0
	J152-1

Connector Type	Phoenix PCV 5/ 4-GF-7,62 BK 4-pin header with mounting screws pitch 7.62mm
Mating Type	Phoenix PC 5/ 4-STF-7,62 BK 4-pin plug with mounting screws pitch 7.62mm

The pinout for J152-0 and J152-1 is provided in the following table:

Table 4-130. J152-0, J152-1 Servo Motor Drive Pinout

Pin #	Signal Designator	Description
1	EGND	Earth Ground (shield)
2	R$	Motor $, R phase; $ = 0 or 1
3	S$	Motor $, S phase; $ = 0 or 1
4	T$	Motor $, T phase; $ = 0 or 1

4.3.2.2.2 B5U-2-45 Jumpers

This section details the settings of the MB5U-2-45 jumpers.

> Only a qualified technician should make any changes to the factory settings of the jumpers. Remove the back cover of the unit to access the jumpers.

The following table provides details of the settings of the MB5U-2-45 jumpers.

Table 4-131. MB5U-2-45A Jumper Settings

Name	Description	Functionality
JP2, JP3,	I2C A0, A1,	Used for setting the I^{2}C address: Set the JP2 & JP3 to: "00" when the motherboard assembly is slot number 0. "01" when the motherboard assembly is slot number 1. "10" when the motherboard assembly is slot number 2. "11" when the motherboard assembly is slot number 3. 0 - the jumper is installed. 1 - the jumper is removed.

4.3.2.3 MB5U-4-XX

The MB5U-4-XX is installed in the MC4U-19-Piano-enc. There are two versions of the MB5U-4 motherboard:

> MB5U-4-60 which supports DDM3U-2/4-60V Drives (see DDM3U-X-60V-4A Low-Power Motor Drive)

> MB5U-4-320 which supports DDM3U-2/4-320V Drives (see DDM3U-2-320V-XA High-Power Motor Drive)

The connectors associated with the MB5U-4-XX are shown in the following figure:

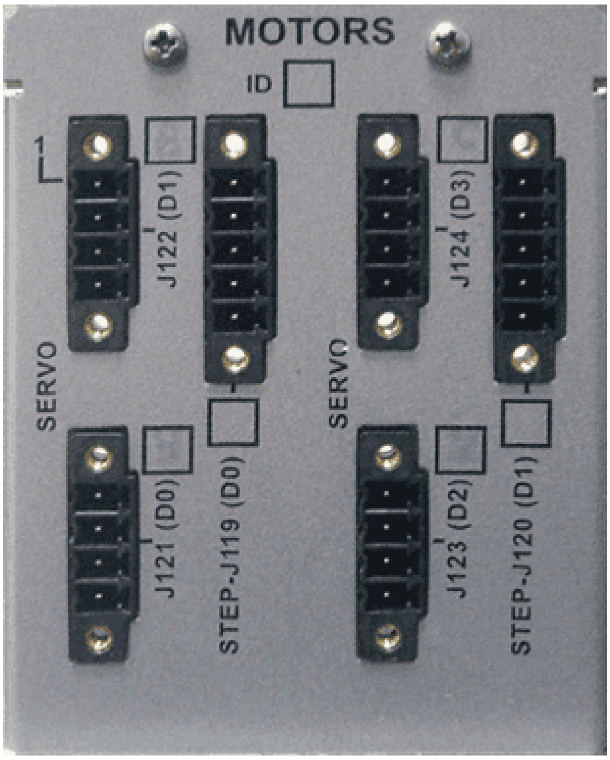


Figure 4-30. MB5U-4-XX Connectors

4.3.2.3.1 MB5U-4-XX Functionality

The MB5U-4-XX accommodates any SPiiPlus Motion Controller, the DDM3U-X-60V-4A low-power motor drive or DDM3U-2/4-320V high-power motor drive (depending on the model that is installed), and power supplies.

The motherboard includes a rear panel with four Servo Motor Drive connectors that are wired to the motor drive, and, as such, the number of connectors depends on the number of Motor Drives installed in the MC4U.

> The panel also contains connectors for step motors but these are not connected.

4.3.2.3.2 Servo Motor Drive Connectors

Label	J121 (D0)
	J122 (D1)
	J123 (D2)
	J124 (D3)
Connector Type	Phoenix MCV 1,5/4-GF-3,81
Mating Type	Phoenix MC 1,5/4-STF-3,81

The Servo Motor Drive connectors are for use with low-power motor drives, such as the DDM3U-4-60V-2A Motor Drive, and, as such, the number of connectors depends on the number of Motor Drives (1 or 2) installed in the MC4U.

The Servo Motor Drive connectors are allocated as follows:

Connector	Axis	Connector	Axis
J122 (D1)	Drive Y(1)	J124 (D3)	Drive B(3)
J121 (D0)	Drive X(0)	J123 (D2)	Drive A(2)

The pinout for the Servo Motor Drive connectors is given in the following table:

Table 4-132. J121-J124 - Low-Power Motor Pinout

Pin #	Signal Designator	Description
1	R_$	Motor $ R phase
2	S_$	Motor $ S phase
3	T_$	Motor $ T phase
4	EGND	Electrical Ground

The following diagrams illustrate how motors are to be connected

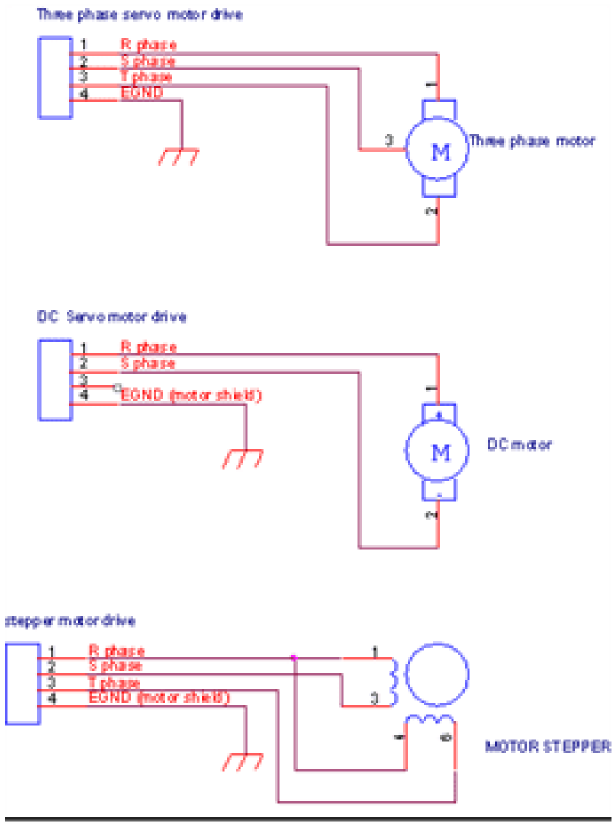


Figure 4-31. MB5U-4 Motor Drive Connections

4.3.2.3.3 MB5U-4-XX Jumpers

This section details the settings of the MB5U-4-XX jumpers.

> Only a qualified technician should make any changes to the factory settings of the jumpers. Remove the back cover of the unit to access the jumpers.

The following table provides details of the settings of the MB5U-4-XX jumpers:

Table 4-133. MB5U-4-XX Jumper Settings

Jumper	Description	Functionality
JP2, JP3, JP4	A0, A1, A2	For setting the I^2C address, set the JP2, JP3, JP4 to: "000" when the motherboard assembly is slot number 0. "001" when the motherboard assembly is slot number 1. "010" when the motherboard assembly is slot number 2. "011" when the motherboard assembly is slot number 3. "100" when the motherboard assembly is slot number 4. "101" when the motherboard assembly is slot number 5. "110" when the motherboard assembly is slot number 6. "111" when the motherboard assembly is slot number 7. 0 - the jumper is installed. 1 - the jumper is removed

4.3.2.4 MB5U-Lin

The MB5U-Lin is installed in the MC4U-19-Piano-enc.

Figure 4-32. MB5U-Lin

4.3.2.4.1 MB5U-Lin Functionality

The MB5U-Lin accommodates the LDM3U Single Axis Linear Amplifier (see LDM3U Single Axis Linear Drive).

4.3.2.4.2 J130(D0) - Drive Motor

Label	J130(D0) - MOTOR
Connector Type	Phoenix MCV 1,5/4-GF-3,81 connector.
Mating Type	Phoenix MC 1,5/4-STF-3,81

The following table provides the pinout for J130(D0) Phoenix connector.

Table 4-134. J130(D0) - Drive Motor Pinout

Pin	Name	Description
1	R	Motor R phase
2	S	Motor S phase
3	T	Motor T phase
4	PF	Electrical Ground

4.3.2.4.3 MB5U-Lin Jumpers

Only a qualified technician should make any changes to the factory settings of the jumpers. Remove the back cover of the unit to access the jumpers.

The following table provides details of the settings of the MB5U-Lin jumpers.

Table 4-135. MB5U-Lin Jumper Settings

Name	Description	Functionality
JP1	18AWG Wire	OFF: Power Sequence Control circuit is used ON: Power Sequence Control circuit is bypassed
JP2, JP3, JP4		ON: ±12Vdc from Power Sequence Control circuit is used OFF: Not Connected
JP5, JP6, JP7, JP8		ON: Is, It drive current feedback signals are used OFF: Not Connected

Name	Description	Functionality
JP9		1-2: AGND is connected to 12_RTN 3-2: AGND is connected to DGND
JP10, JP11		ON: R_CMD analog command for phase "R" is used OFF: Not Connected
JP12, JP13, JP14	I2C A0, A1, A2	Used for setting the I^2C address: Set the JP12, JP13 & J14 to: "000" when the motherboard assembly is slot number 0. "001" when the motherboard assembly is slot number 1. "010" when the motherboard assembly is slot number 2. "011" when the motherboard assembly is slot number 3. "100" when the motherboard assembly is slot number 4. "101" when the motherboard assembly is slot number 5. "110" when the motherboard assembly is slot number 6. "111" when the motherboard assembly is slot number 7. 0 - the jumper is installed. 1 - the jumper is removed.

4.3.2.5 MB5U-LinM

The MB5U-LinM (shown in the following figure) is installed in the MC4U-19-Piano-enc.

Figure 4-33. MB5U-LinM

4.3.2.5.1 MB5U-LinM Functionality

The MB5U-LinM accommodates the LDM3U Single Axis Linear Amplifier (see LDM3U Single Axis Linear Drive).

4.3.2.5.2 J130(D0) - Drive Motor

Label	J130(D0) - MOTOR
Connector Type	F.C.I. DBV9W4S3000H30LF D-Type 9W4 connector.
Mating Type	FCT FM9W4P-K120 D-Sub-Mixed-Layout

The following table provides the pinout for J130(D0) connector.

J130(D0) - Drive Motor Pinout

Pin	Name	Description
A1	R	Motor R phase
A2	S	Motor S phase
A3	T	Motor T phase
1-5		Not in use
A4	PF	Electrical Ground

FMP005P103 adapters have to be installed by the user in connector pins A1, A2, A3 and A4.

4.3.2.5.3 MB5U-LinM Jumpers

> Only a qualified technician should make any changes to the factory settings of the jumpers. Remove the back cover of the unit to access the jumpers.

The following table provides details of the settings of the MB5U-LinM jumpers.

Table 4-136. MB5U-LinM Jumper Settings

Name	Description	Functionality
JP1	18AWG Wire	OFF: Power Sequence Control circuit is used ON: Power Sequence Control circuit is bypassed
JP2, JP3, JP4		ON: ±12Vdc from Power Sequence Control circuit is used OFF: Not Connected
JP5, JP6, JP7, JP8		ON: Is, It drive current feedback signals are used OFF: Not Connected
JP9		1-2: AGND is connected to 12_RTN 3-2: AGND is connected to DGND
JP10, JP11		ON: R_CMD analog command for phase "R" is used OFF: Not Connected
JP12, JP13, JP14	I2C A0, A1, A2	Used for setting the I^2C address: Set the JP12, JP13 & J14 to: "000" when the motherboard assembly is slot number 0. "001" when the motherboard assembly is slot number 1. "010" when the motherboard assembly is slot number 2. "011" when the motherboard assembly is slot number 3. "100" when the motherboard assembly is slot number 4. "101" when the motherboard assembly is slot number 5.

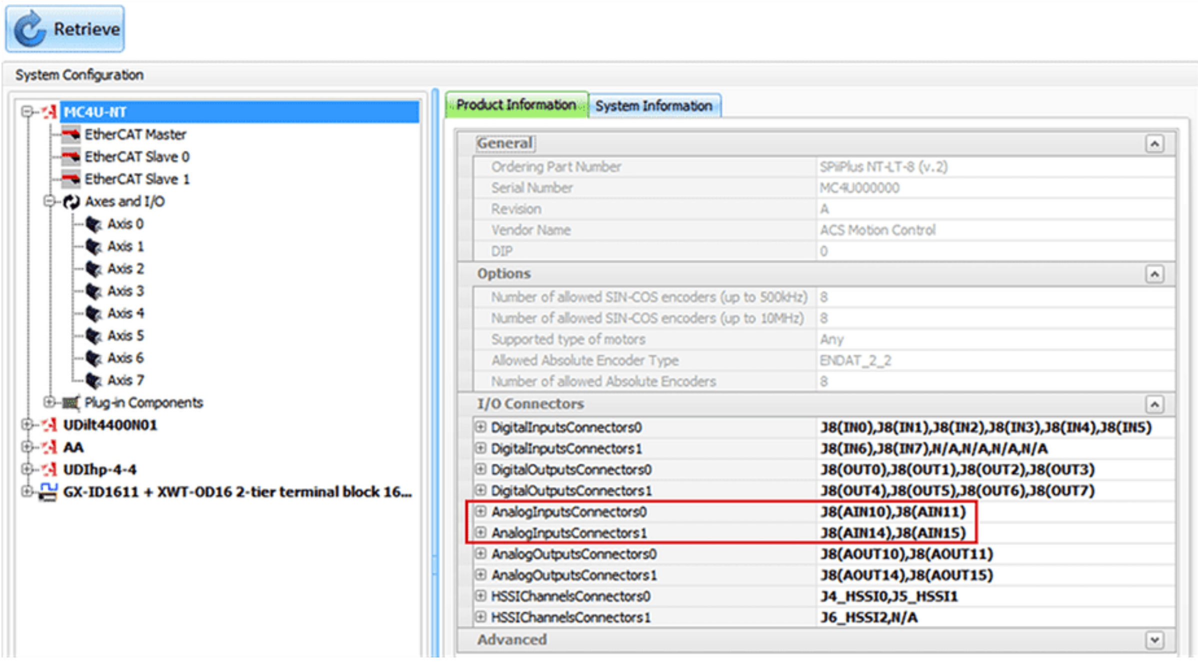
Name	Description	Functionality
		"110" when the motherboard assembly is slot number 6. "111" when the motherboard assembly is slot number 7. 0 - the jumper is installed. 1 - the jumper is removed.

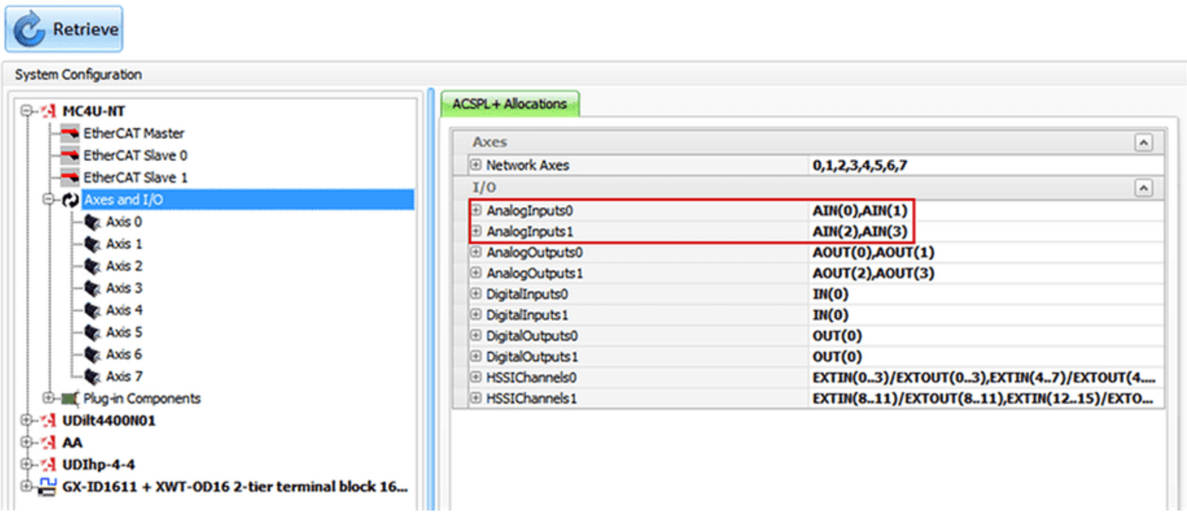
4.4 Feedback and IO Diagrams

4.4.1 MC4U I/O Naming Conventions

I/O numbering assignment of ACSPL+ variables is determined during system setup. It varies according to the specific system and the MC4U location in the network. Default values are assigned (shown in the examples below for analog inputs), but you can change them later through the SPiiPlus MMI Application Studio. For more details for how to view specific system IO numbering, see the *SPiiPlus MMI Application Studio User Guide*.

In the following screenshot examples, Connector J8 (IO) analog input pins AIN10, AIN11, AIN14, AIN15 are related to ACSPL+ variables: AIN(0), AIN(1), AIN(2), AIN(3).





4.4.2 Incremental Digital Encoder Interface

The digital encoder channel A, Channel B and Index inputs are built around 26C32 line receivers with 120Ω termination resistors. The use of encoders with built-in line drivers, such as AM26C31 or similar, is recommended. The following figure is an example (for the X-axis) of an incremental encoder connection.

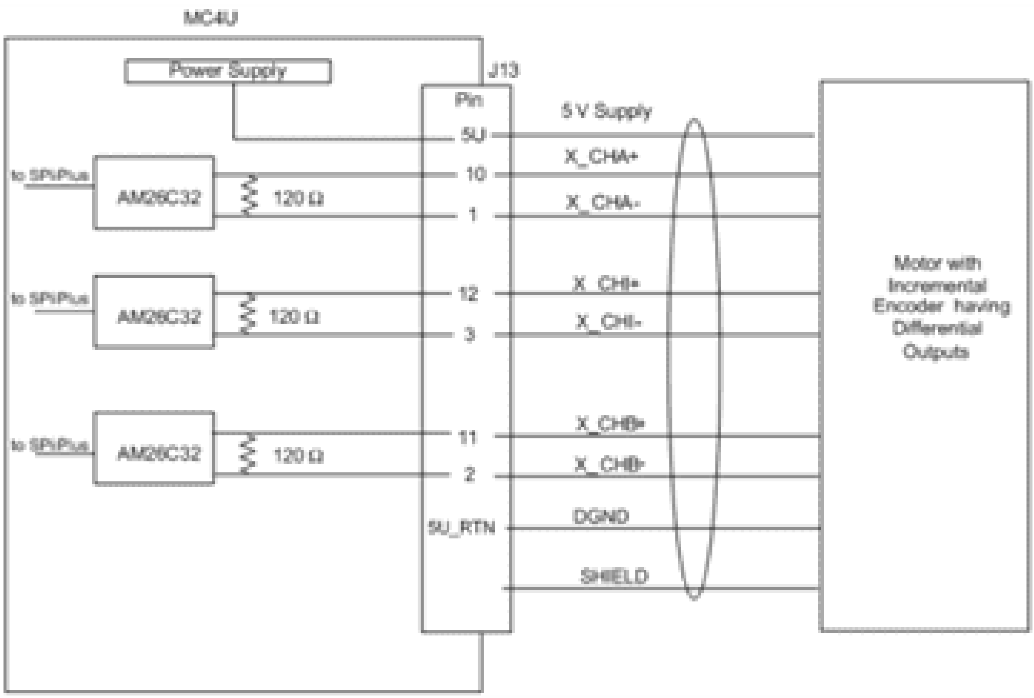


Figure 4-34. Incremental Digital Encoder Interface (X-axis)

4.4.3 Sin-Cos Encoder Input

The following figure illustrates the Sin-Cos encoder interface for an X-axis.

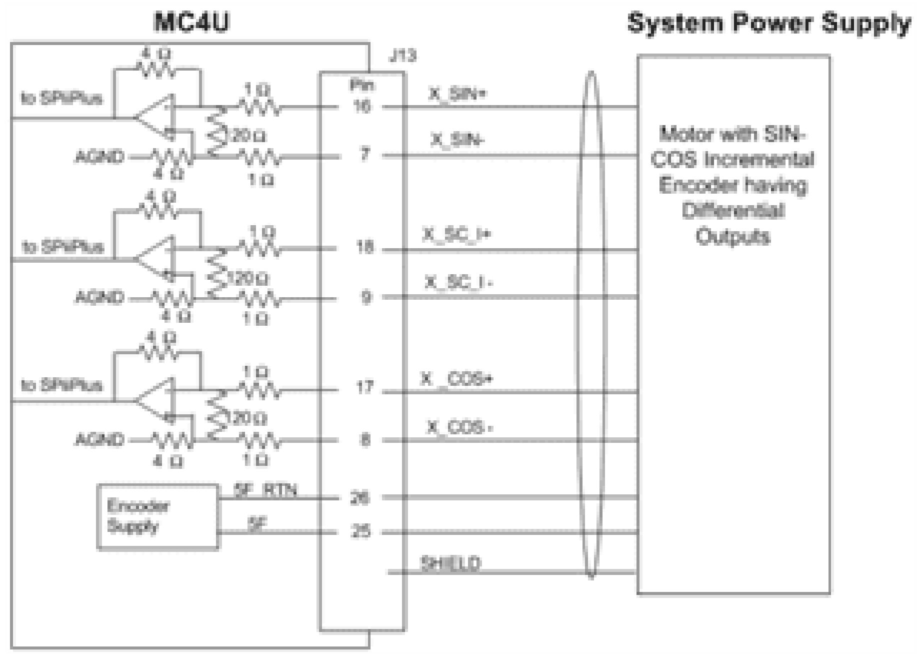


Figure 4-35. Sin-Cos Encoder Interface

4.4.4 Absolute Encoder Interface

Absolute encoder's interfaces (pins and electrical circuitry) are shared with Digital Incremental (AqB) and with Sin-Cos encoder's interfaces, according to the table below:

Table 4-137. Absolute Encoder Reference

Absolute Encoder Type	Encoder Interface	Controller Interface
BiSS C/SSI	RS422 receiver data (encoder output)	CHA
	RS422 Clock (encoder input)	CHB (controller's output)
Endat 2.2	RS485 bidirectional data	CHA
	RS422 Clock (encoder input)	CHB (controller's output)
Hiperface	RS485 bidirectional data	CHA
	Sin output	Cos input
	Cos output	Sin input
Sanyo Denki	RS485 bidirectional data	CHA
SmartABS/ Panasonic	RS485 bidirectional data	CHA

The digital bidirectional communication data channel is shared with CHA (data).

The Clock line interfaces to the controller's CHB.

Hiperface uses in addition to the digital bidirectional data channel the analog Sin and Cos interfaces, as illustrated in the following figure:

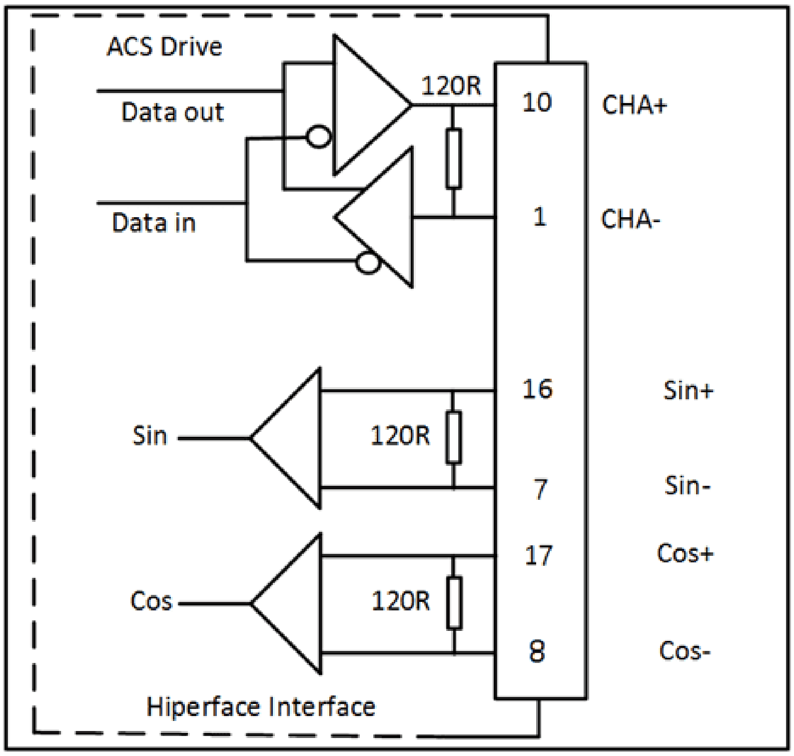


Figure 4-36. Absolute Encoder Hiperface Schematic Diagram

Hiperface encoders required an external power supply of 7-12Vdc.

A bi-directional RS485 data channel uses CHA of the digital incremental encoder, and when clock is provided to the encoder, then CHB of the corresponding digital incremental encoder is used, see Figure 4-37 and Figure 4-38 below.

The setting is performed by software.

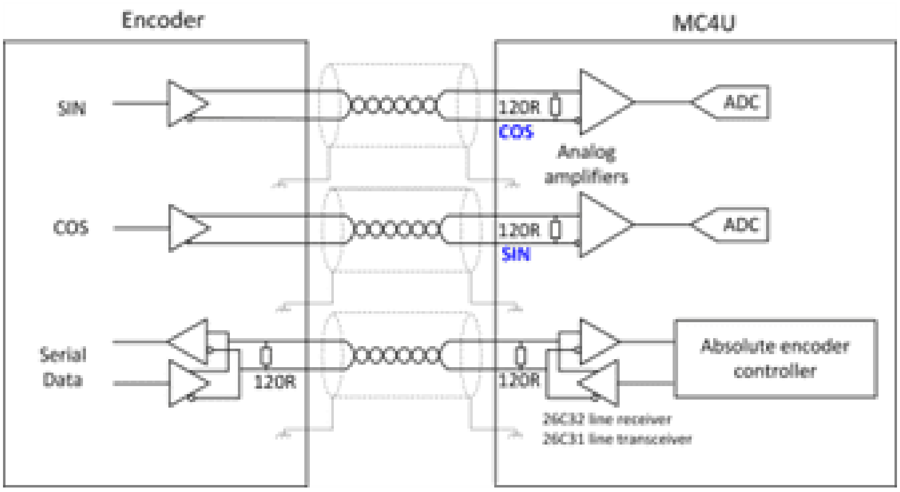


Figure 4-37. Absolute Encoder Schematic Diagram

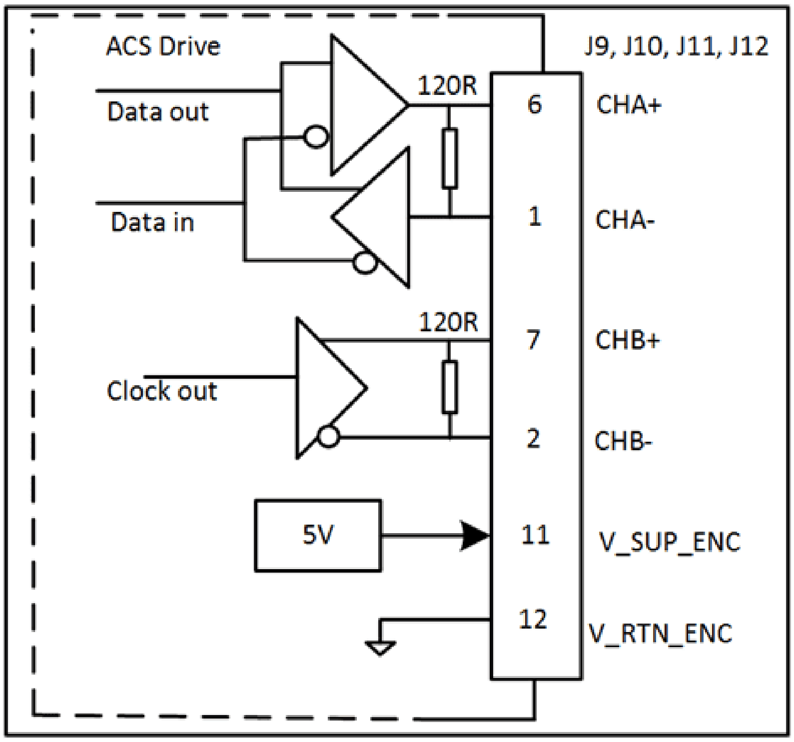


Figure 4-38. Absolute Encoder Bidirectional Schematic Diagram

4.4.5 I/O Interface

The following figure provides an example of an I/O interface for an X-axis, ±5V, single-ended, ±10V differential PWM , 10 bit resolution, and filtered by second order filter.

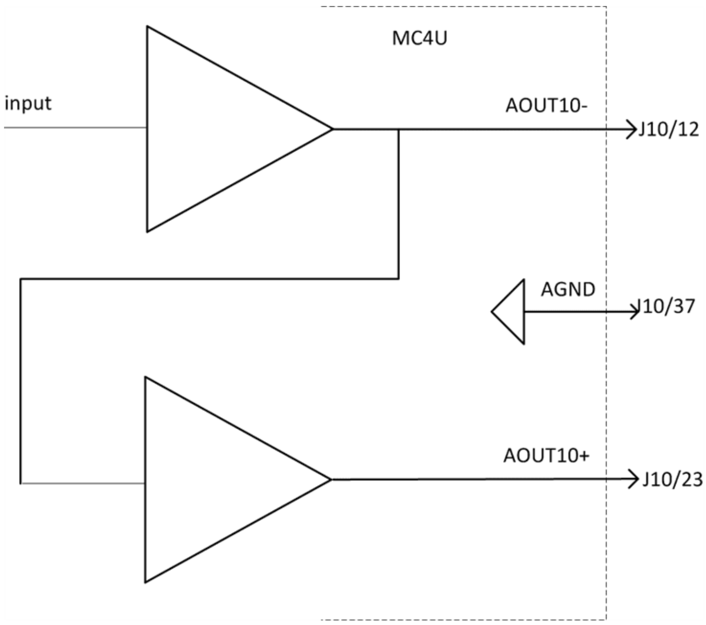


Figure 4-39. I/O Interface Schematic Diagram

4.4.6 Hall Interface

The following figure provides an example illustrating the Hall interface for an X-axis.

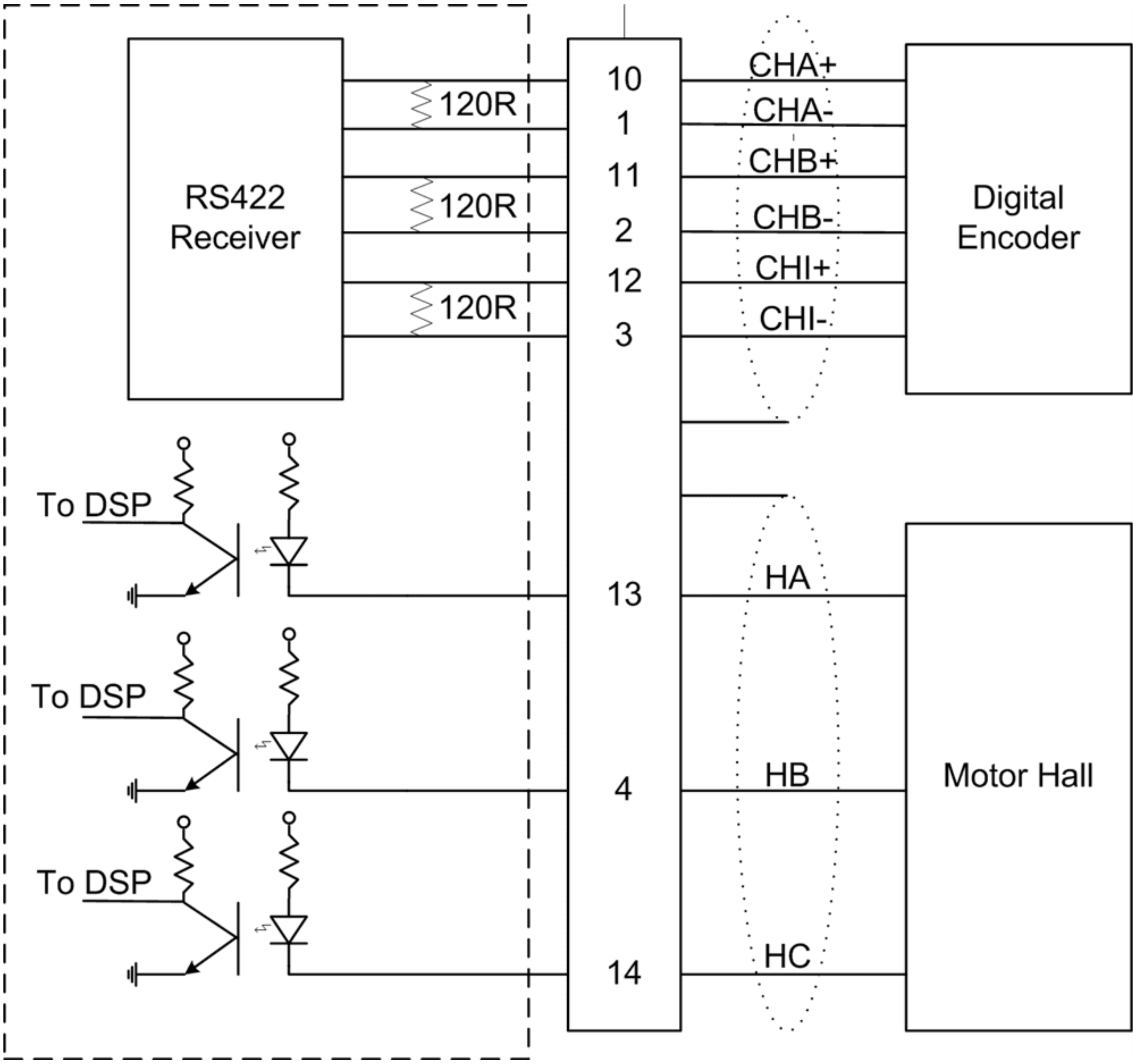


Figure 4-40. Hall Interface Schematic Diagram

4.4.7 Motor Temperature Input

The following figure shows the motor temperature input for the X-axis.

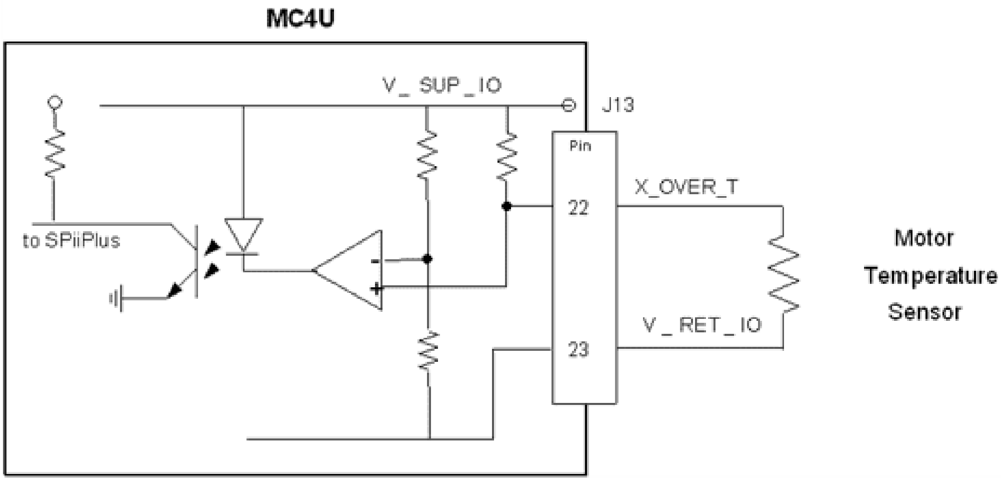


Figure 4-41. Connection to Motor Temperature Input (X-axis)

4.4.8 Emergency Stop Input

The following figure illustrates the emergency stop input interface for an X-axis.

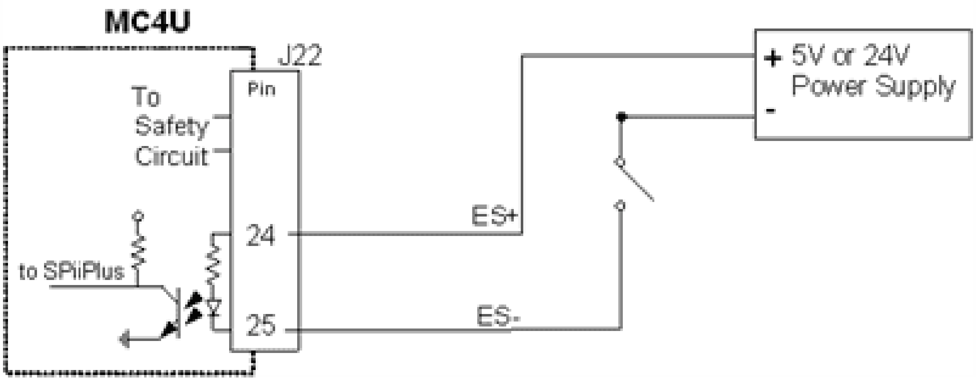


Figure 4-42. Connection for Emergency Stop Input

4.4.9 MARK1 Registration Digital Input

The following figure provides an example illustrating the MARK1 input interface for an X-axis.

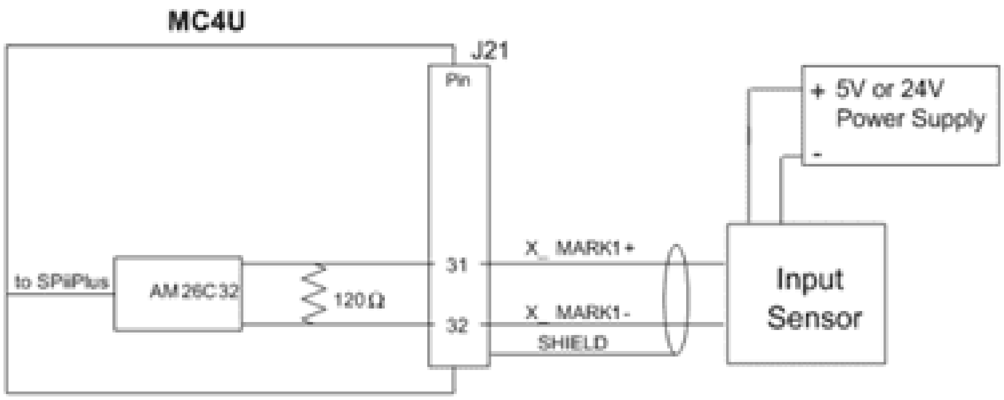


Figure 4-43. Differential Connection for MARK1 Input (X-axis)

4.4.10 PEG Pulse Output

The following figure is an example (for the X-axis) of a PEG pulse output.

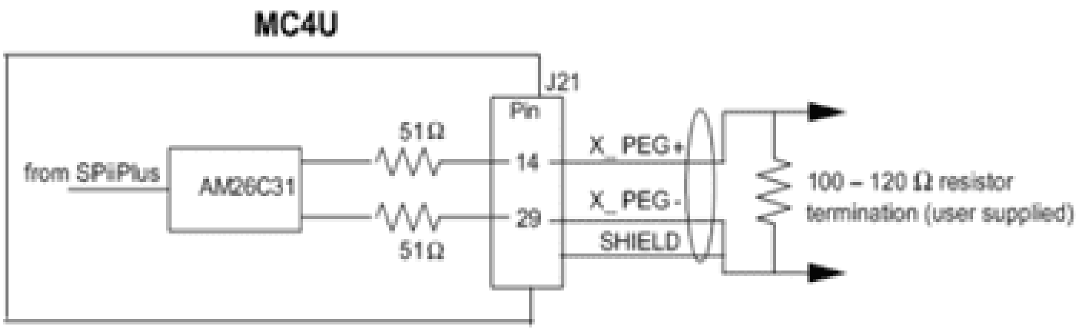


Figure 4-44. PEG Pulse Digital Output Connection (X-axis)

A user-supplied 100-120Ω resistor must be installed between the differential signals of the PEG outputs.

PEG does not work with absolute encoders

4.4.11 Joystick Input Interface

To configure the differential analog inputs (not Sin-Cos) to work with 0 to 10V, 39 kΩ resistors have to be connected in series to the analog input pins, as shown in the following figure:

The user should be aware that in this configuration the resolution is reduced by a factor of 2.

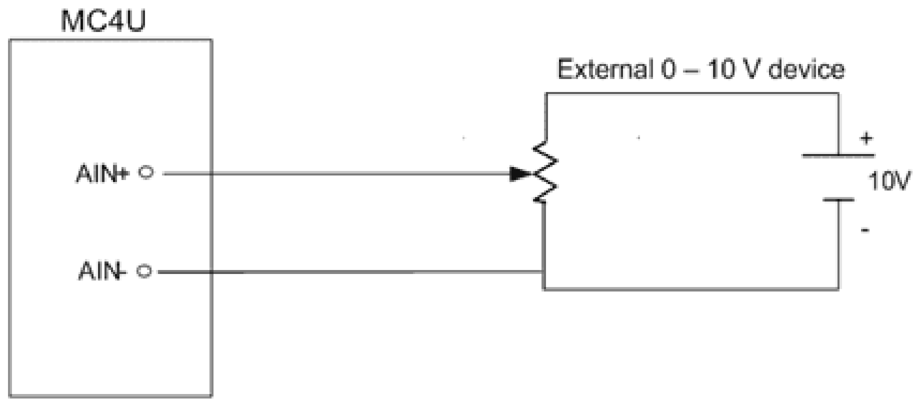


Figure 4-45. Analog Inputs with 0-10V Configuration

The following figure illustrates a typical joystick configuration.

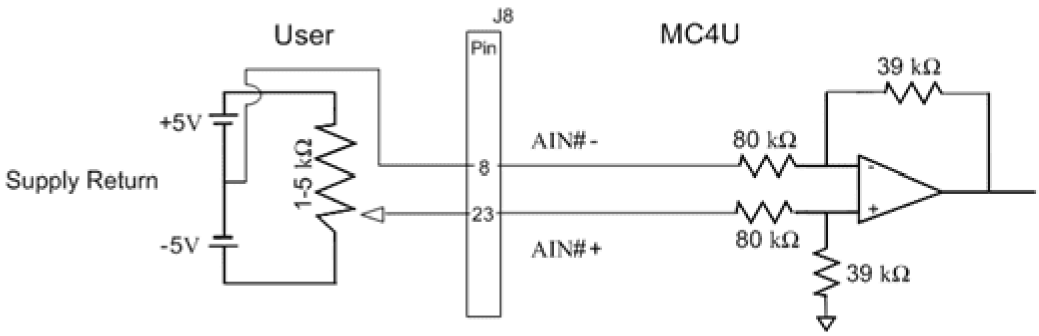


Figure 4-46. A ±5V Differential Joystick through AIN

5. Safety and EMC Guidelines

5.1 Certification

The following standards and certificates apply to the MC4U -NPcontrol module:

Table 5-1. International Standards & Certificates Applicable to MC4U-NP

Category	Standard
Safety	EN 61010-1:01
Safety	ANSI/UL 508C
EMC	EN 61326:2002
EMC	SEMI F47-0200

The following figure shows the standards organization marks that appear on the MC4U Control Module.

The CE marking indicates that the MC4U meets all the essential requirements of the relevant European Directive(s).

Figure 5-1. Standards Organization Marks

The ‘C’ and ‘US’ indicators adjacent to the Underwriters’ Laboratories Recognized Component Mark signify that the MC4U has been evaluated to the applicable CSA and ANSI/UL Standards for use in Canada and the U.S., respectively. The ‘US’ indicator includes products eligible to bear the ‘NRT’ indicator. NRT, i.e., National Recognized Testing Laboratory, is a designation granted by the U.S. Occupational Safety and Health Administration (OSHA) to laboratories which have been recognized to perform certification to U.S. Standards 163785, January 25, 200223301637853.

> The DDM3U-4-60V-2A Motor Drive is not UL certified. It does, however, meet all relevant CE requirements.

5.2 MC4U Environmental Parameters

The following table provides the environmental parameters for MC4U operation.

Table 5-2. MC4U Environmental Specification

Parameter	Value
Ambient Temperature	Rated range of operation from 0 to + 40°C
Environmental conditions: Storage	IEC 60721-3-1 (class 1K3 and 1M3)
Environmental conditions: Transportation	IEC 60721-3-2 (class 2K4 and 2M3)
Environmental conditions: Operating	IEC 60721-3-3 (class 3K3 and 3M4)

5.3 General Safety Guidelines

Under emergency situations the MC4U must be completely disconnected from any power supply. The E-Stop Inputs and Left/Right Limits of the MC4U are designed for use in conjunction with customer-installed devices to protect driver load. The operator is responsible for complying with all Electrical Codes.

Connecting or disconnecting the motor without disabling the drive first can potentially damage the drive.

5.3.1 MC4U Handling & Maintenance

It is absolutely forbidden to touch the MC4U unit or component for maintenance purposes whenever power is being applied.

Whenever any MC4U maintenance has to be performed, all cables and input power to the unit have to be disconnected. A period of 30 seconds to allow complete voltage discharge must be strictly adhered to before removing the MC4U or disassembling any of its components.

5.3.2 Emergency Stop Device

An emergency stop device must be located at each operator control station and other operating stations where an emergency stop may be required. The emergency stop device must be able to disconnect any electrical equipment connected to the unit from the power supply. It will not be possible to restore the circuit until the operator manually resets the emergency stop. In situations with multiple emergency stop devices the circuit shall not be restored until all emergency stops devices have been manually reset.

5.3.3 Fail Safe Logic Recommendation

ACS Motion Control recommends connecting all safety inputs (limit inputs and emergency stop input) with a fail safe logic whenever the normal operation the inputs are active.

> When an unsafe event happens, the input becomes zero and the controller identifies this as a fault.

5.3.4 Initial Logic State of Outputs

The relevance of analog and digital output pins is configuration-dependent. The initial logic state of the inactive analog and digital pins is undefined. They might carry a potential of 5V relatively to ground.

5.3.5 Electrical Separation

Electrical separation is required between the control and power supply cables to prevent electrical shock or damage to the equipment.

5.3.6 Over-Travel Protection

> Over-travel limit protection must be provided where over-travel is hazardous. The over-travel limiting device must be capable of interrupting the power circuit.

5.3.7 Thermal Detection

> Suitable thermal detection devices to interrupt the power circuit must be installed where abnormal temperatures can cause a hazardous condition.

5.3.8 Power Supply and Motor Cable Ground

The power supply cable and the motor cable must have a ground wire that is connected to the protective earth terminal located on the motor and power connectors. A connection must also be made between the grounding post (located on the MC4U enclosure) and the equi-potential bar inside electrical enclosure.

5.4 General Wiring and EMC Guidelines

5.4.1 External AC Line Filters

In order to comply with the EN 61326:2002, line filters must be employed. The line filters for single phase input AC are given in Table 5-3 and those for three phase input AC are given in Table 5-4.

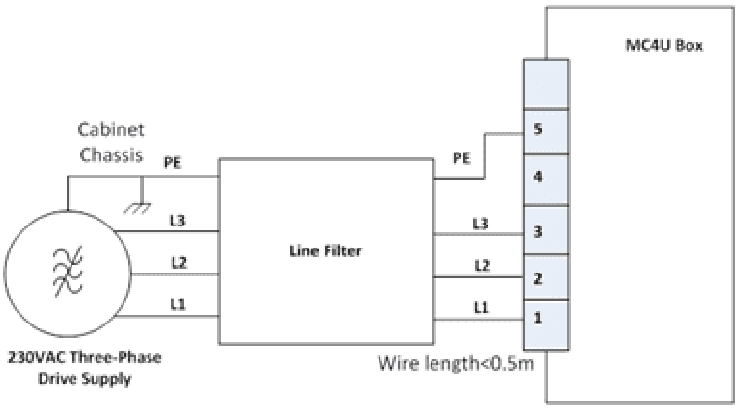
Table 5-3. Line Filters for Single Phase AC Input

Input Current [A rms]	Line Filter Type
8	B84142B0008R000 Epcos
12	B84142B0012R000 Epcos
16	B84142B0016R000 Epcos
25	B84142B0025R000 Epcos
36	B84143B0036R110 Epcos

Table 5-4. Line Filters for Three Phase AC Input

Input Current [A rms]	Line Filter Type
8	B84143B0008R000 Epcos
12	B84143B0012R000 Epcos
16	B84143B0016R000 Epcos
25	B84143B0025R110 Epcos
36	B84143B0036R110 Epcos

The cables between the line filter output and MC4U are to be as short as possible (less than 0.5m).



An input main supply transformer is required. The line filter is to be located on the primary side.

5.4.2 ACS Motor Filters

In order to comply with the EN 61326:2002, ACS motor filters must be employed.

5.4.3 Routing Signal and Power Cables

Power cables (to the motors, mains outlet, etc.) and signal cables (to I/O, encoder, RS-232, etc.) must be kept as far apart as possible. Keep at least an inch (~2.5 cm) for each 3 feet (~1 m) of between cables running in parallel as illustrated in the following figure. For example, if the motor and encoder cables run parallel for 6 feet (~2 m), maintain a 2 inch (~5 cm) separation between them.

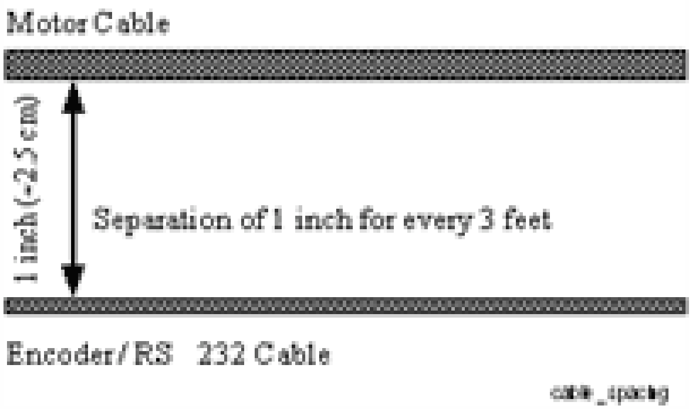


Figure 5-2. Cable Spacing

It is recommended to use completely shielded cables as illustrated in the following figure:

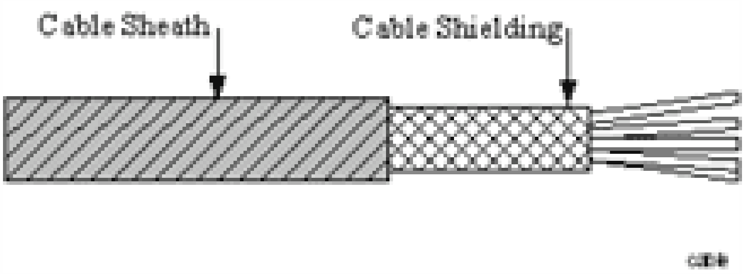


Figure 5-3. Shielded Cable

5.4.4 Cable Length

Use short cable runs, and route cables as far from other EMI sources as possible.

- The motor phase cable should not be more than 10 meters in length, shielded, and the shield wire should be connected to both the motor and the MC4U motor connector (PE terminal).
- The encoder cable should not be more than 10 meters in length, shielded, and the shield wire should be connected to both the motor and the MC4U encoder connector.

5.4.5 Grounding

Grounding of the system electrical components is crucial in two aspects:

5.4.5.1 Safety Grounding

Verify that all electric circuits and electrical components, including motion controllers, power drives, motors, etc., have a grounding system. The grounding of AC and DC equipment shall be in accordance with section 29 CFR 1910.304(g) of Occupational Safety and Health Administration (OSHA) Standard 29 CFR 1910.304 Paragraphs (g)(1) through (g)(9) of this section contain grounding requirements for systems, circuits, and equipment.

5.4.5.2 High Frequency Grounding

The primary objective of a high-frequency ground system is to provide a well defined path for HF currents and to minimize the loop area of the HF current paths. It is also important to separate HF grounds from sensitive circuit grounds. A single-point, parallel-connected ground system is recommended.

The power supply cable and the motor cable must have a ground wire that is connected to the protective earth terminal located on the motors. A connection must also be made between the protective earth screw (located in the center of the MC4U Interface, shown in the following figure) and the equi-potential bar inside the Mechanical Housing.

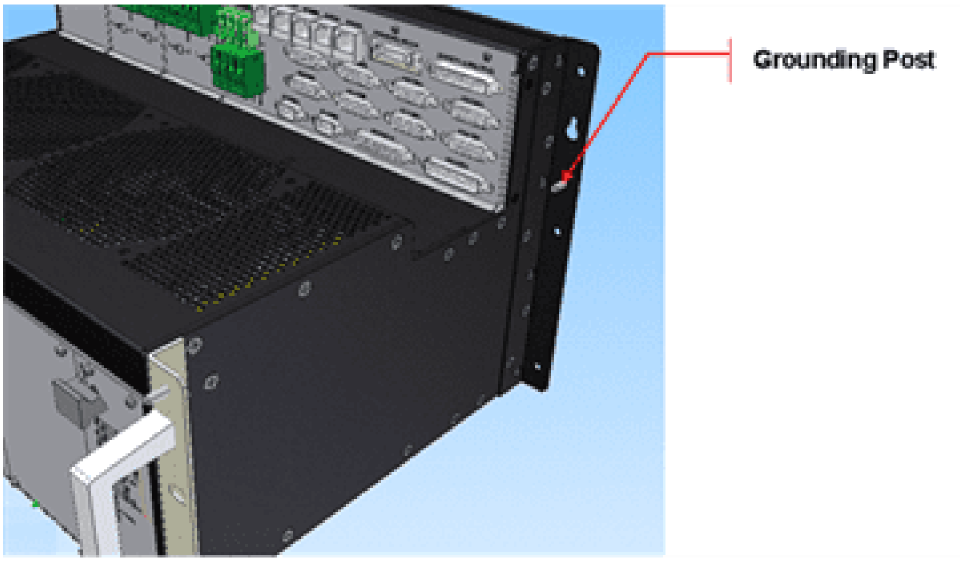


Figure 5-4. MC4U Grounding Post

5.5 Mechanical Brake

Negative values of **BOFFTIME** are not supported in this product. If a negative value is assigned the firmware will throw either Error 5072, "Driver Alarm: Overcurrent" or error 5061, "Driver Alarm: Short Circuit".

6. Circuit Protection

This section contains details of the various protection circuits and devices contained in the MC4U to ensure safe operation.

6.1 Internal Integrated Drive Protection Circuits

6.1.1 Soft Start Circuit

When AC voltage is initially applied to the MC4U PSM3U Power Supply (through connector J14), a 10 second delay is required until the power supply is ready and can accept an ENABLE command for any axis. Otherwise the power supply may be damaged.

The Soft Start circuit eliminates high inrush current when AC input voltage is applied to the power section of the PSM3U-320V-XXkW power supply. The Soft Start circuit also protects against damage the power transistors in power amplifiers during the power up in case of any of the amplifier outputs is shorted to the electrical ground (EGND).

The maximum inrush current value is 3.75A.

The Soft Start circuit consists of Soft Start resistor (100Ω resistance and 100W nominal power), NTC resistor (inrush current protection) and Soft Start Relay driven by the Soft Start control circuit.

When AC input voltage is applied to the power section of the PSM3U-320V-XXKw. power supply, the electrolytic capacitors are charged via the Soft Start and NTC resistors. The Soft Start control circuit will switch ON the Soft Start Relay after a 4.8 - 7.2 Sec time delay, which will bypass the Soft Start and NTC resistors. If AC input voltage is disconnected for more than 36 mSec, the Soft Start control circuit will be reset within 5-10 mSec.

6.1.2 Motor Regeneration Circuit

An internal or an external (optional) Regeneration resistor can be used in the Regeneration circuit to absorb the motors' regeneration energy. The Regeneration circuit is activated when the DC BUS output voltage exceeds 400V±3% (388 - 412V) and protects the DC BUS electrolytic capacitors from the extra DC voltage stress (450V maximum voltage surge value for these capacitors).

Internal regeneration resistor is used to absorb the motor's regeneration energy less then 100W rms. This resistor is connected to J9 connector on PSM3U-100V-3kW board when the external regeneration resistor is not used. If the external regeneration resistor is used, the internal regeneration resistor must be disconnected from connector J9; otherwise it will work in parallel with the external resistor and heat the power supply heatsink to no effect.

The internal regeneration resistor value is 100Ω, 100W (2kW peak).

An external regeneration resistor can be used to absorb the motor regeneration energies of more than 100W rms. This resistor can be connected to REG1 user connector that is located on the power supply motherboard.

The external regeneration resistor value depends on the application. The minimum value is 15Ω.

6.1.3 PSM3U Low-Power PS

- Power supply fault status reading may be due to:
  - Drive Supply Alarm: Power supply is missing (AC input is missing)
  - Drive Supply Alarm: Temperature too high
  - Drive Supply Alarm: Drive supply too high
  - Drive Supply Alarm: Over current
- Power supply card identification reading includes:
  - Power supply card serial number
  - Power supply card revision
  - Power supply card date of production
  - Power supply type

6.1.4 PSM3U High-Power PS

- Power supply fault status reading may be due to:
  - Drive Supply Alarm: “component fault: phase lost”
  - Drive Supply Alarm: “component fault: power down”
  - Drive Supply Alarm: “component fault: power supply not ready”
  - Drive Supply Alarm: “component fault: regeneration fault”
  - Drive Supply Alarm: “component fault: temperature too high”
- Power supply fault cause status resetting:

If a power supply fault signal goes to “0” due to a power supply fault condition, the controller can reset the fault cause status information.

- Power supply card identification reading includes:
  - Power supply card serial number
  - Power supply card revision
  - Power supply card date of production
  - Power supply type

6.1.5 DDM3U Low-Power Motor Drive

In DDM3U-4-06-XX-Y power block the I^2C bus is used for the following, non-real-time purposes:

- Drive fault status reading includes:
  - Drive Alarm: Power supply too high
  - Drive Alarm: Power supply too low
  - Drive Alarm: Short circuit
  - Drive Alarm: Temperature too high
  - Drive fault cause status resetting:

If a “$ Drive Fault” signal goes to “1” due to a drive fault condition, the controller can reset the fault cause status information.

If a “$ Drive Enable” or “Brake” command is issued, the fault cause status information should be reset.

- Drive card identification reading includes:
  - Drive card serial number
  - Drive card revision
  - Drive card date of production
  - Drive type: Number and type of assembled power bridges, Drive supply voltage, Drive output current

6.1.6 DDM3U High-PowerDDM3U-1-XXXV-15A-NP Motor Drive

In DDM3U-2-320V-YY driver the I^2C bus is used for the following, non-real-time purposes:

- Drive fault status reading includes:
  - Drive Alarm: Power supply too high
  - Drive Alarm: Power supply too lowmissing
  - Drive Alarm: Short circuit
  - Drive Alarm: Over current
  - Drive Alarm: Temperature too high
  - Drive fault cause status resetting

  If a “$ Drive Fault” signal goes to “1” due to a drive fault condition, the controller can reset the fault cause status information. This switches the PWM Power Bridge (Power Amplifier) status LED “PA$” to “Off” as well.

  If a “$ Drive Enable” command is issued, the fault cause status information is to be reset.

- Drive card identification reading includes:
  - Drive card serial number
  - Drive card revision
  - Drive card date of production
  - Drive type: Number of assembled power bridges, Drive supply voltage, Drive output current

6.2 Fuses

> Blown fuses should be replaced by ACS Motion Control. Any damage resulting from customer replacement of blown fuses will be the responsibility of the customer.

The circuitry of the MC4U is protected by a number of fuses. The following sections provide details of fuses, by MC4U module.

6.2.1 PSM3U Power Supply Fuses

The number of fuses in the PSM3U Power Supply module depends on whether the Low-Power PS or the High-Power PS is installed.

6.2.1.1 PSM3U Low-Power AC Input Power Fuses

The AC input power section is protected by a fuse, the parameters of which are:

> Type: Time Delay, ceramic tube
> Ampere rating: 15A
> Voltage rating: 250Vac
> Agency approvals: UL, CSA

If this fuse blows, all motor drivers supplied from the power supply are disabled.

6.2.1.2 PSM3U Low-Power 24Vdc Logic Supply Input Fuses

The 24Vdc input circuit is protected against shorts or overloads as the result of the control supply internal circuits damage by a fuse, the parameters of which are:

- Type: Very fast acting, SMT
- Ampere rating: 5A
- Voltage rating: 125Vac/dc
- Agency approvals: UL, CSA

If this fuse blows, all motor drivers supplied from the power supply are disabled.

6.2.1.3 PSM3U High-Power AC Input Power Fuses

The AC input power section is protected by three fuses (one fuse for each input phase), the parameters of which are:

- Type: Time Delay, ceramic tube
- Ampere rating: 30A fast
- Voltage rating: 250Vac
- Agency approvals: UL, CSA

If one or more of the fuses blows, all motor drivers supplied from the power supply are disabled.

6.2.2 DDM3U Motor Drives Fuses

6.2.2.1 DDM3U-X-60V-4A Low-Power Motor Drive Fuses

The DDM3U-X-60V-4A Low-Power Motor Drive has the following fuses:

Control supply input fuse:

- Type: subminiature, very fast action
- Ampere rating: 2A
- Voltage rating: 125Vdc
- Agency approvals: UL

Drive supply input fuse:

> Type: very fast-acting,
> Ampere rating: 15A
> Voltage rating: 65Vdc
> Agency approvals: UL

In addition, there is protection against erroneous connection of the control supply with reverse polarity, in this case the control supply will not start to operate.

6.2.2.2 DDM3U-2-320V-YY High-Power Motor Drive Fuses

The DDM3U-2-320V-YY High-Power Motor Drive has the following fuses:

Control supply input fuse:

- Type: subminiature, very fast action
- Ampere rating: 2A
- Voltage rating: 125Vdc
- Agency approvals: UL

Drive supply input fuse:

- Type: fast-acting
- Ampere rating:
  - 15A for DDM3U-2-320V-5A
  - 30A for DDM3U-2-320V-10A and DDM3U-2-320V-20A
- Voltage rating: 600Vdc
- Agency approvals: UL

In addition, there is protection against erroneous connection of the control supply in reverse polarity, in this case the control supply will not start to operate.

6.3 Fault Handling

The SPiiPlusNT/DC-NP motion controller constantly monitors the drive input supply and if it detects a fault, it issues a warning message.The following table lists the fault conditions and the actions that the MC4U takes, as well as the warning messages that SPiiPlusNT/DC-NP generates.

Table 6-1. Fault Handling

Condition	Action Taken	Remarks
Drive supply too high	> DDM3U-4-06-02: Disables all drivers when DC BUS voltage exceeds 72±5%. SPiiPlusNT/DC-NP generates the message: “Drive Alarm: Power supply too high”. > DDM3U-2-30-XX:DDM3U-1-XXXV-15A-NP Disables all drivers when DC BUS voltage exceeds 445±5%. SPiiPlusNT/DC generates the message: “Drive Alarm: Power supply too high”.	
Drive supply missing	Disables all drivers when the drive power supply is missing or the drive power supply voltage is less than 19.5V±5% (18.5 - 20.5V). SPiiPlusNT/DC-NP generates the message: “Drive Alarm: Power downsupply is missing”.	
24Vdc control supply missing	Disables the drives when the drive 24Vdc control supply is missing or 24Vdc control supply input fuse is blown. SPiiPlusNT/DC-NP does not generate a message. The protection is activated only when the 24Vdc was working properly and then stopped.	
Phase lost (for three-phase AC input supply only)	In the event that one of the AC input supply phases is lost or one of the AC input fuses is blown all axis drivers which are supplied by this power supply are disabled. SPiiPlusNT/DC-NP generates the message: “Drive Supply Alarm: Phase lost”.	JP6 jumper should be installed in thePSM3U-320V-XXkW board if a three-phase input supply is used.

Condition	Action Taken	Remarks
Drive phase-to-phase or phase-to-ground short circuit	Disables the corresponding drive when the current through one of the outputs of the PWM Power Bridge exceeds its maximum rating: > 25A ±5% for DDM3U-2-30-05 > 50A ±5% for DDM3U-2-30-10 > 40A-120A ±5% for DDM3U-2-30-20 > 7.5A ±5% for DDM3U-4-06-02 SPiiPlusNT/DC-NP generates the message: “Drive Alarm: Short circuit”.	
Drive over temperature	Disables the corresponding drive when the temperature in the PWM Power Bridge area is greater than 100±5^{o}C. SPiiPlusNT/DC-NP generates the message: “Drive Alarm: Temperature too high”.	
Power supply not ready	Disables all drivers during a Soft Start period. SPiiPlusNT/DC-NP generates the message: “Drive Alarm: Power supply not ready”.	
Power supply missing	If the AC input supply is disconnected or one AC input fuse is blown (in the case of the single phase input supply), or more than one AC input fuse is blown (in the case of the three-phase input supply), all axis drivers which are supplied by this power supply are disabled. SPiiPlusNT/DC-NP generates the message: “Drive Supply Alarm: Power supply is missing”.	
Power supply over voltage	When the power supply output voltage is more than the tolerance range: 60-70V, the power supply (only the 48V) is shut down.	For over voltage fault recovery, the AC input must be removed and reapplied.
Power supply over temperature	When the temperature in the power supply is more than: > 100-130°C for the PSM3U Low-Power PS > 90±5^{o}C for the PSM3U High-Power PS The power supply is shut down. All axis drivers which are supplied by the power supply are disabled.	To recover from the over temperature fault, the AC input must be removed and reapplied.

Condition	Action Taken	Remarks
	SPiiPlusNT/DC-NP generates the message: "Drive Supply Alarm: Temperature too high".	
Power supply over current	When the current via the output voltage is more than 18.25A, the power supply (only the 48V) is shut down.	
Drive over current	Disables the corresponding drive when the current through one of the outputs of the PWM Power Bridge exceeds its maximum rating: > 15A ±5% for DDM3U-2-30-05 > 30A ±5% for DDM3U-2-30-10 > 60A ±5% for DDM3U-2-30-20 SPiiPlusNT/DC-NP generates the message: "Drive Alarm: over current".	
Regeneration fault	Disables all drivers when there is a short-circuit on the regeneration resistor (internal or external). SPiiPlusNT/DC-NP generates the message: "Drive Alarm: Regeneration Fault".	

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